BEST CPUs WITH INTEGRATED GRAPHICS | FOR BUDGET BUILDERS

apc

FEB 2020 #477

YOUR EXPERT GUIDE TO TODAY'S TECH

GET MORE SPACE
WHAT TO DO WHEN YOUR DISK IS FULL

INDESIGN vs THE REST
THE BEST DESKTOP PUBLISHING APPS FOR MAC

MASTER AUDIOBOOKS
RIP, CONVERT & STREAM TO ALL YOUR DEVICES

BEST FREE SOFTWARE

FROM VIDEO EDITING TO MEDIA PLAYBACK, OFFICE WORK & SECURITY

ALL THE TOOLS YOU NEED THAT COST NOTHING!

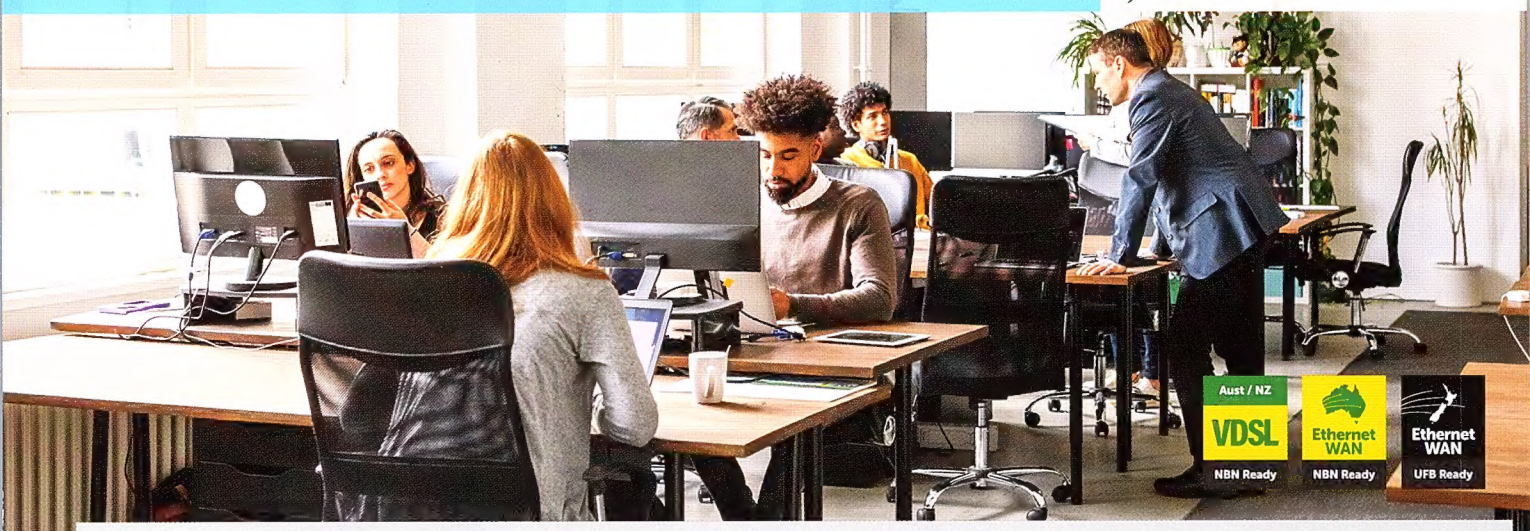
UTURE
AUS$9.95 INC GST
NZ$10.90 INC GST
PRINT POST
APPROVED: 100000179
ISSN: 0725-4415
02
313006 001362

DIY GUIDES & PRO-TIPS
MASTER THE APPLE TV APP • EDIT AND SYNC NOTES SECURELY • KEEP YOUR RASPBERRY PI 4 COOL

TESTED
MACBOOK PRO 16
PLUS: NVIDIA 1650 SUPER vs AMD 5500 XT • AMAZON ECHO STUDIO • TP-LINK AX11000 + MORE

NBN SMB Solution for VDSL2 & Ethernet WAN
(FTTN/B, FTTP, HFC, Fixed Wireless, Satellite)

DrayTek Aust & NZ
www.draytek.com.au



Vigor2862 Series

apc RECOMMENDS

Multi-WAN VDSL2/ADSL2+ router with 1 x configurable GbE WAN/LAN port, 4 x GbE LAN ports, SPI Firewall, 802.11ac Wi-Fi, VoIP and 32 x VPN tunnels including 16 x SSL-VPN

32x VPN

Vigor2862Vac

- VDSL2/ADSL2+, 1 x configurable GbE WAN/LAN port, dual USB ports for failover and load-balancing
- Two USB 2.0 ports for connection to two 3.5G/4G LTE USB mobiles, FTP server and network printer
- 4 x Gigabit LAN ports with multiple subnets and 50,000 NAT sessions
- Integrated IEEE 802.11ac (AC2000) wireless Access Point; dual band; up to 1.7Gbps throughput
- IPv6 & IPv4
- Increased IP addresses (1022) and IP subnets (8)
- VoIP (2 x FXS and 1 x FXO Line Port) for Vigor2862Vac
- Object-based SPI Firewall and CSM (Content Security Management) for network security
- 16 x VLANs for secure and efficient workgroup management
- 32 x VPN tunnels (including 16 x SSL VPN tunnels) with Load Balance and Redundancy
- Fast VPN throughput, VPN load-balancing and backup for site-to-site applications
- High Availability mode
- Embedded Central VPN Management for 8 remote Vigor routers
- Central AP Management for deployment of multiple wireless VigorAPs
- Works with Smart Monitor Network Traffic Analyzer (30-nodes)
- Works with VigorACS 2 Central Management for multi-site deployment

Vigor2762 Series

VDSL2/ADSL2+ router with 1 x configurable GbE WAN/LAN port, 3 x GbE LAN ports, SPI Firewall, 802.11ac Wi-Fi, and 2 x VPN tunnels including 2 x SSL-VPN

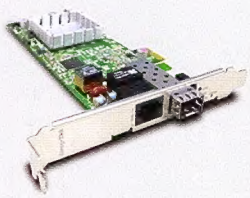
Vigor2762Vac

2x VPN

- 1 x VDSL2/ADSL2+ WAN port
- 1 x configurable GbE WAN/LAN port
- 3 x GbE LAN ports with 50,000 NAT sessions
- 2 x USB ports for 3G/4G LTE mobile broadband access, USB printer and storage
- VDSL2 vectoring
- IPv6 & IPv4
- Object-based SPI Firewall, CSM (Content Security Management) and QoS for network security
- 2 x VPN tunnels including 2 x SSL-VPN tunnels
- Integrated IEEE 802.11ac (AC1200) wireless Access Point
- SIP VoIP (2 x FXS ports)
- Works with VigorACS 2 (Central Management System)

VigorNIC 132F

VDSL2/ADSL2+ PCI Express NIC with SPI Firewall and SFP secondary WAN port



- 1 x VDSL2/ADSL2+ WAN port
- 1 x SFP port for optic fibre or UTP interface module
- VDSL2 vectoring
- Bridging for VDSL2 and ADSL2+
- Object-oriented SPI Firewall
- IPv6 & IPv4
- Support Windows 8, Windows 10 & Ubuntu
- Multi-PVC for triple-play application
- VigorACS 2 management system

Vigor130

VDSL2/ADSL2+ modem/router

TAIWAN EXCELLENCE 2014

- 1 x VDSL2/ADSL2+ WAN port
- 1 x Gigabit Ethernet LAN port
- VDSL2 vectoring
- Bridging for VDSL2 and ADSL2+
- Object-oriented SPI Firewall
- IPv6 & IPv4
- Works with VigorACS 2 management system

i-LAN TECHNOLOGY

i-LAN Technology Pty Ltd trading as DrayTek Aust & NZ

www.i-lan.com.au (02) 9838 8899 sales@i-lan.com.au

© Copyright 2018 i-LAN Technology Pty Ltd. All rights reserved.

apc

Subscription enquiries:
(02) 8227 6486, future@crmaus.com.au

Future Publishing Australia
PO Box 1077 Mount Street,
North Sydney, NSW 2059
Tel: (02) 9955 2677 **Fax:** (02) 9955 2688
Email: apcmag@futurenet.com
Web: www.apcmag.com

Editorial
Editor: **Ben Mansill** ben.mansill@futurenet.com
Senior Journalist: **Shaun Prescott**
Journalist: **Joel Burgess**
Journalist: **Harry Domanski**
Journalist: **Stephen Lambrechts**
Journalist: **Sharmishta Sarkar**
Creative Director: **Troy Coleman**
Designer: **Sharnee Swinnerton**

Contributors
Anthony Agius, Neil Bothwick, Matthew Connatser, Christian Guyton, Lindsay Handmer, Malindy Hetfield, Marshall Honorof, Hollin Jones, Jeremy Laird, Srivats Lakshman, Carrie Marshall, Howard Oakley, Nick Peers, Les Pounder, Nick Ross, Chris Szewczyk, Mark Williams, Darren Yates.

Photography
All copyrights and trademarks are recognised and respected

Advertising
Group Advertising Manager: **Cameron Ferris**
cameron.ferris@futurenet.com

Management
Managing Director: **Neville Daniels**
Sales Director: **Paul Marttila**

Printed by Blue Star PRINT (NSW)

Distributed in Australia and NZ by Ovato **ovato.com.au**

ISSN 0725-4415

We are committed to only using magazine paper which is derived from responsibly managed, certified forestry and chlorine-free manufacture. The paper in this magazine was sourced and produced from sustainable managed forests, conforming to strict environmental and socioeconomic standards. The manufacturing paper mill holds full FSC (Forest Stewardship Council) or PEFC certification and accreditation

All contents © 2018 Future Publishing Australia or published under licence. All rights reserved. No part of this magazine may be used, stored, transmitted or reproduced in any way without the prior written permission of the publisher. Future Publishing Limited (company number 2008885) is registered in England and Wales. Registered office: Quay House, The Ambury, Bath BA1 1UA. All information contained in this publication is for information only and is, as far as we are aware, correct at the time of going to press. Future cannot accept any responsibility for errors or inaccuracies in such information. You are advised to contact manufacturers and retailers directly with regard to the price of products/services referred to in this publication. Apps and websites mentioned in this publication are not under our control. We are not responsible for their contents or any other changes or updates to them. This magazine is fully independent and not affiliated in any way with the companies mentioned herein.

If you submit material to us, you warrant that you own the material and/or have the necessary rights/permissions to supply the material and you automatically grant Future and its licensees a licence to publish your submission in whole or in part in any/all issues and/or editions of publications, in any format published worldwide and on associated websites, social media channels and associated products. Any material you submit is sent at your own risk and, although every care is taken, neither Future nor its employees, agents, subcontractors or licensees shall be liable for loss or damage. We assume all unsolicited material is for publication unless otherwise stated, and reserve the right to edit, amend, adapt all submissions.

Privacy statement
If you provide information about yourself this will be used to provide you with products or services you have requested. We may supply your information to contractors to enable us to do this. Future Publishing Australia will also use your information to inform you of other publications, products, services and events. Future Publishing Australia may also give your information to organisations that are providing special prizes or offers and are clearly associated with the Reader Offer. Unless you tell us not to, Future Publishing Australia may give your information to other organisations that may use it to inform you of other products, services or events. If you would like to gain access to the information Future Publishing Australia holds about you, please contact us.

Future plc is a public company quoted on the London Stock Exchange (symbol: FUTR)
www.futureplc.com

Chief executive **Zillah Byng-Thorne**
Non-executive chairman **Richard Huntingford**
Chief financial officer **Penny Ladkin-Brand**

Tel +44 (0)1225 442 244

Free is good

Don't pay if you don't need to.

You can't argue with the value of free. That's especially true if you need to take care of something as a one-off, and need a particular app to use for the task. It's tough to justify spending money on anything in these circumstances, especially when there's a free option. All of the big, popular apps have a free alternative out there somewhere. And, that's been our mission this issue – to compile a collection of *APC*-recommended apps to cover just about any job.

Of course, for things you do regularly, or perhaps professionally, then a fully featured paid app is hard to beat. But no matter where you look there's a free option. Whether it's office software, security, video, image, or audio editing – you can probably make do without forking out for a big-dollar equivalent.

While we didn't get into gaming in this feature, I can share a couple of tips for grabbing free fun here. The new (and often maligned) Epic Games Store gives away a free game or two each week, and they can be good ones, too. Get them by installing the Epic Games app and check in regularly. Amazon Prime members can score freebies via the Twitch App (**www.twitch.tv**), and there's a growing selection to pick from – and while they're usually smaller, indie games or older classics, there's nothing wrong with that and some golden treasures are there waiting for you. Also keep an eye on GOG and Humble Bundle for freebies.

Another topic that I hope is of interest to many of you is audiobooks. Personally, I'm addicted and my commute is now almost entirely consumed by audiobook listening – replacing the podcasts I used to listen to, but hardly ever do now. If you like the idea of enjoying your audiobooks on more than one device, as well as bringing some order to your collection – which could even include creating your own server or NAS that can stream to any of your devices – then turn to page 56 and have at it.

In more mundane news, we've got a tutorial showing you how to free up some disc space. While not terribly exciting, it is rather essential. After all, who wants to just keep adding local or network storage when a bit of tinkering can negate that cost? So get stuck in and unclog your drives and get things nice and trim. Personally, I need some unclogging after the Xmas excess, and a bit of trimming couldn't hurt... til next time.

BEN MANSILL
EDITOR
ben.mansill@futurenet.com

"Of course, for things you do regularly, or perhaps professionally, then a fully featured paid app is hard to beat. But no matter where you look there's a free option."

exclusive software

» HOW TO DOWNLOAD YOUR FREE FULL-VERSION PROGRAMS

ISSUE 477, FEBRUARY 2019

Please note that these exclusive downloads will only be available for a limited time, from **27/01/2020 to 15/03/2020**

PERFECT YOUR PRECIOUS PHOTOGRAPHS

EDIT AND IMPROVE IMAGES WITH ASHAMPOO PHOTO OPTIMIZER 2019.

FULL VERSION WORTH $30

Photo editing doesn't have to be time-consuming! With Ashampoo Photo Optimizer 2019, all it takes is a single click to improve your photos significantly. The integrated image optimisation auto-detects dull colours, unsuitable colour temperatures or poor exposure and instantly fixes these defects! The software even features a more advanced analysis to auto-optimise white exposure and contrast spreads. Thanks to its sophisticated algorithm, this photo editing software is your weapon of choice to optimise your photos!

DOWNLOAD LINK: **www.ashampoo.com/lpa/apcmagazine**

KEEP YOUR DRIVE IN A SOLID STATE

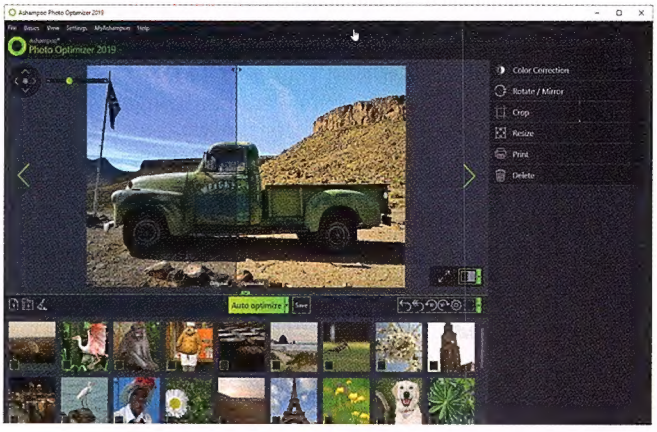
OPTIMISE SSD PERFORMANCE WITH ABELSSOFT SSD FRESH.

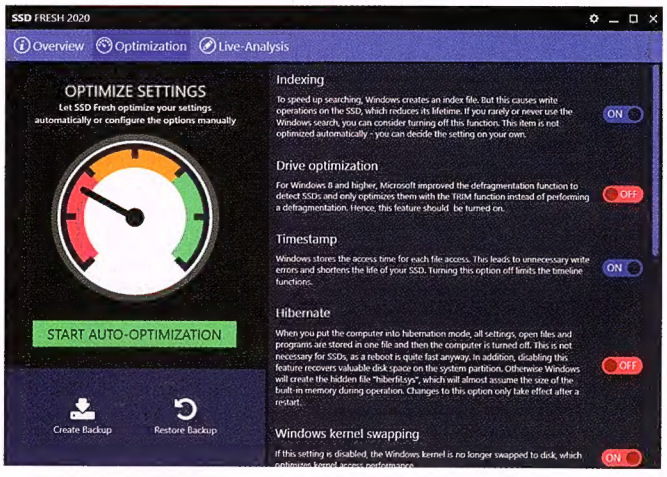
FULL VERSION WORTH $17

Unlike hard drives, SSDs don't use magnetised metal plates, but digital memory cells, which are addressed directly. The problem: you have a limited number of read and write operations. SSD Fresh can reduce the data access from many superfluous and automated Windows features. The tool also includes Windows defragmentation, indexing of files, timestamp creation, a prefetch function, boot file defragmentation, the Windows-logging, system recovery (if another backup system is used) and storing of short names for folders and files.

DOWNLOAD LINK: **www.apcmag.com/exclusives**

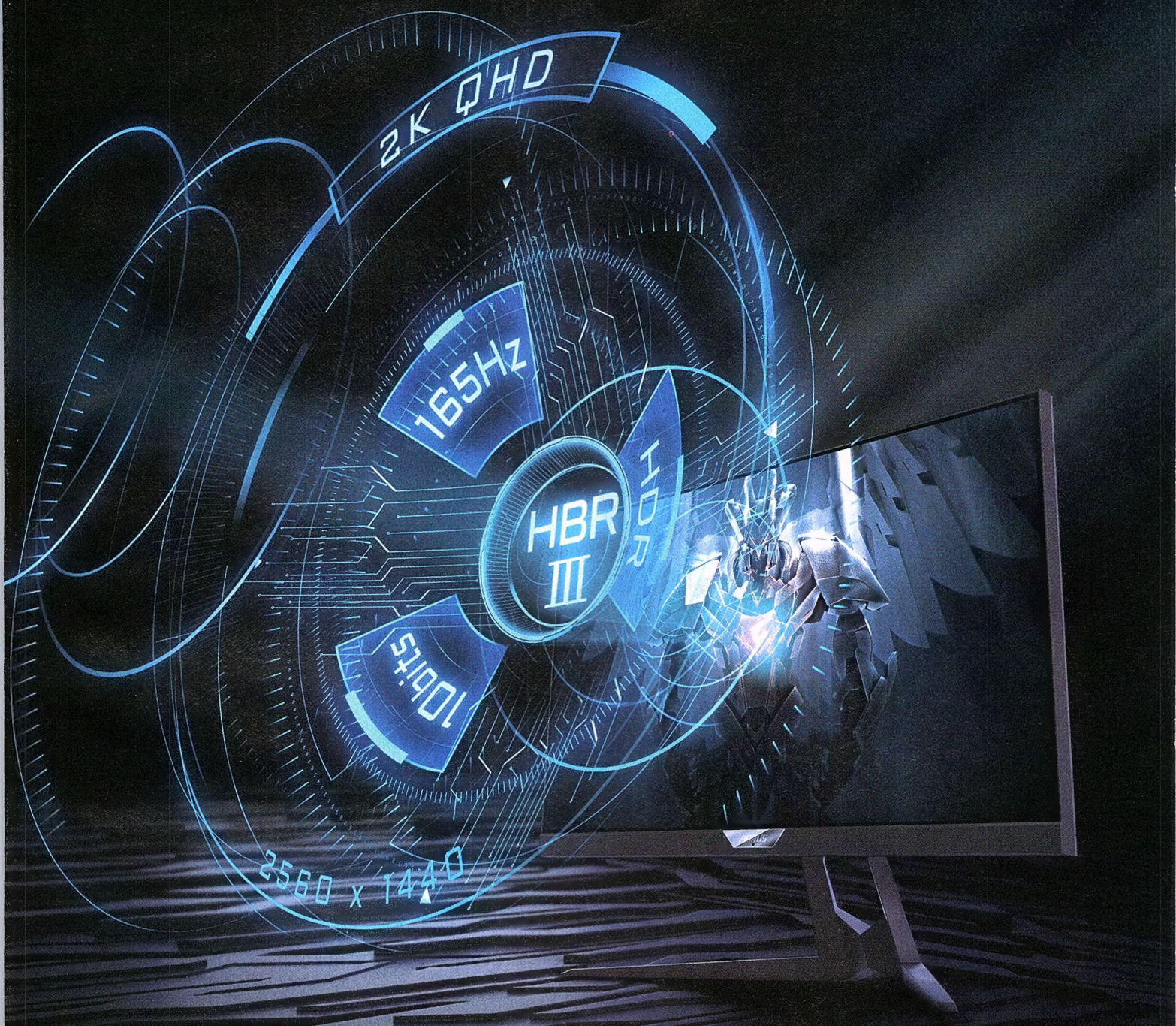
DOWNLOAD ZIP PASSWORD: **January20a (password is case-sensitive)**





DISCLAIMER Future Publishing is not the licensor of the exclusive software or any documentation included with it. Rather, Future is merely a distributor of the software, and your use of the software is subject to any accompanying third-party licence terms. You must carefully read and comply with any such third-party licence terms, together with all instructions and README files that come with the software. Accordingly, to the maximum extent permitted by law, all software is provided by Future 'as is' and without warranty, either express or implied, and Future will not be liable for any damage that you may incur as a result of using any software downloads. You should back up any important system and data files before using any downloaded software. We recommend that you do not use the exclusive software on a production machine. Nothing in this disclaimer excludes any warranty that may be implied by statute, which may include the Trade Practices Act. While we have taken all reasonable steps to check the software downloads for viruses, we cannot guarantee that it is free from viruses or other harmful code and you should check each download using a virus scanner complete with the latest antivirus updates before use.

AORUS



NEW AORUS MONITOR LINEUP HAS LANDED!

FI27Q & FI27Q-P

HBR3 allows you to enjoy 2K, 165Hz, HDR, 10 bits color AT THE SAME TIME

ANC 2.0 | BLACK EQUALIZER 2.0 | NVIDIA G-SYNC | AMD FREESYNC TECHNOLOGY

▲ LEARN MORE

GIGABYTE

Issue 477 February 2020

Contents

BEST FREE SOFTWARE

48

FROM VIDEO EDITING TO MEDIA PLAYBACK, OFFICE WORK & SECURITY
ALL THE TOOLS YOU NEED THAT COST NOTHING!

56

TAKE CONTROL OF YOUR AUDIOBOOKS

RIP, CONVERT, AND STREAM YOUR AUDIOBOOK COLLECTION TO ANY DEVICE.

features

4 BEST FREE SOFTWARE
From video editing to media playback, office work & security All the tools you need that cost nothing!

56 TAKE CONTROL OF YOUR AUDIOBOOKS
Rip, convert, and stream your audiobook collection to any device, with Nick Peers.

62 THE BEST DESKTOP PUBLISHING APPS FOR MAC
You needn't spend a fortune to lay out pages and format documents better.

66 FREE UP SOME SPACE
How can you ensure your PC doesn't run out of storage capacity? Nick Peers has some pointers…

technotes

10 NEWS
All the big news

14 TECH BRIEF
TSMC's 5nm process is making big progress

16 GADGETS
Lovely little bits and pieces

18 TWO BITS
The 2020s will see the rise of the quantum computer

20 END USER
Moderating content for Google or Facebook is dangerous and dangerously underpaid

22 RANDOM ACCESS
Are you being spied on?

23 NUMBER CRUNCH
We look at the numbers driving the big tech news

24 HOW IT'S DONE
Surface Pro 7

26 HEAD TO HEAD
Ryzen 3322G vs Core i3-9100 vs Athlon 3000G

"Whatever you want to do, do it, and pay absolutely nothing in the process." *page 48*

28 ASUS ZENBOOK 14

40 ARDUINO NANO 33 IOT

37 AMAZON ECHO STUDIO

32 TP LINK AX11000

36 ASROCK 5700 XT TAICHI

the lab

LATEST REVIEWS

26 Apple 16in Macbook Pro
28 Asus Zenbook 14
29 HP Zbook X2
30 Alienware m17
31 HP DreamColor Z31X Studio Display
32 TP Link AX11000
33 Draytek Vigor2620Ln
34 Gigabyte Nvidia 1650 Super
35 MSI AMD 5500 XT
36 Asrock 5700 XT Taichi
37 Amazon Echo Studio
38 Nvidia Shield
39 Aten USB-C Gen 2 Sharing Switch
40 Arduino Nano Every
41 Arduino Nano 33 IOT

PC BUILDER

76 System News
77 Market Watch
78 Blueprint

SOFTWARE

42 Windows
44 Apple Mac
45 iOS
46 Android
47 Linux

how to

QUICK TIPS

80 We fix your tech problems

TUTORIALS

88 Edit and sync Notes securely
90 Master the Apple TV app
92 Keep your Raspberry Pi 4 cool
96 Run 32-bit apps in Catalina

MASTERCLASSES

96 Push live system stats to the cloud
98 Get some Android 9.0 Pie on your PC
102 Google's TensorFlow 101

downtime

104 GAMING NEWS
What's happening in the world of fun

106 GAMING REVIEWS
High-performance playtime

108 GAME CHANGER
The Curse of Monkey Island

114 CHIP CHAT
Quirky news from the world of geekdom

BEST CPUs WITH INTEGRATED GRAPHICS
FOR BUDGET BUILDERS
apc
FEB 2020 #477
YOUR EXPERT GUIDE TO TODAY'S TECH
GET MORE SPACE
WHAT TO DO WHEN YOUR DISK IS FULL
INDESIGN vs THE REST
THE BEST DESKTOP PUBLISHING APPS FOR MAC
MASTER AUDIOBOOKS
RIP, CONVERT & STREAM TO ALL YOUR DEVICES
BEST FREE SOFTWARE
FROM VIDEO EDITING TO MEDIA PLAYBACK, OFFICE WORK & SECURITY
ALL THE TOOLS YOU NEED THAT COST NOTHING!
DIY GUIDES & PRO-TIPS
MASTER THE APPLE TV APP • EDIT AND SYNC NOTES SECURELY • KEEP YOUR RASPBERRY PI 4 COOL
TESTED
MACBOOK PRO 16
PLUS: NVIDIA 1650 SUPER vs AMD 5500 XT • AMAZON ECHO STUDIO • TP-LINK AX11000 • MORE

the lab » latest reviews
LABS BENCHMARK RESULTS
LAPTOP
$1,949 | ASUS.COM/AU
Asus Zenbook 14 UX434FL
This 13-inch form factor ultrabook has a 14-inch display and a second touchscreen trackpad, but is this dual-display more trouble than it's worth?
Verdict
28 www.apcmag.com

Inside APC

Find out all about *APC*'s editorial policies, test practices, how to read the benchmark results, and more.

APC is Australia's oldest consumer technology magazine – having been consistently in print for over 35 years, since our first issue way back in May 1980 – and we take that heritage and responsibility very seriously. While our focus is obviously on the personal computer – it's in our name, after all – the very definition of the PC has changed and shifted markedly since the early 1980s. As such, we touch on many other areas of tech, too, from smartphones and apps to peripherals, accessories, online services and beyond. We have two main goals: to track down the best of modern tech and also to help our readers make the most of it.

We're also an open church in terms of platforms. We know most people aren't wed to a single brand's products and use a variety of devices. And, like you, *APC*'s journalists want to know what's good in tech – no matter what platform it resides on.

INDEPENDENT REVIEWS

Championing technology doesn't mean we're unrelenting yes-men and -women, however, and *APC* aims to be as objective as possible in all our coverage. That means identifying the best products from multiple perspectives – the best performance, best value and best features and, ideally, the products that offer the best mix of these three.

As a matter of policy, reviews published in *APC* are not shared with product-makers prior to print. We will contact vendors under certain conditions; for example, if we have a problem testing a product that seems to indicate it may be faulty, or to invite a vendor to clarify how a particular feature works. If an *APC* reviewer has any potential conflicts of interest involving a brand, the review will always be assigned to another writer.

LABS TESTING

Despite being a small magazine with limited resources, *APC* still strives to conduct the most rigorous, objective scientific tests and benchmarks we can so as to make our reviews as unbiased as possible. We use a variety of tools and programs for this, including many freely available benchmark suites for assessing media encoding, general system performance, gaming and battery life.

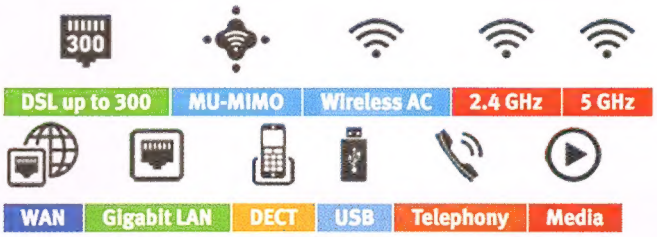
In most cases, for the benchmark results published in *APC*, you can assume that higher is better. There are certain tests that deviate from this rule where the opposite is true; in those cases, we've flagged the results with a note explaining as such.

We use both tables and graphs for displaying results; the latter are our preference due to their ease-of-readability, but tables are more compact, so we use these in cases where thoroughness is preferred.

Quality entertainment around the clock
Enjoy great entertainment throughout the entire home network.
Keep everything as simple as possible.

GERMAN DESIGN AWARD WINNER 2018

AVM Fritz!Box 7590
Made in Germany



FRITZ!Apps for iOS and Android

Encrypted communication via VPN

Smart WiFi technology Multi-User MIMO

At home anywhere with MyFRITZ!

Two wireless networks for more flexibility

Answering machine with voice to mail

Band steering: smart band selection convenience

Ready for the future with IPv6

Mesh WiFi with FRITZ! enjoy full mesh networking

Connected in no time with WPS (Wi-Fi Protected Setup)

First International Trading Pty Ltd
35/7-9 Percy Street, Auburn NSW 2144

Phone: (02) 8318 3777
Email: sales@firstint.com.au

firstint.com.au

technotes

» HARRY DOMANSKI & BEN MANSILL BRING YOU THE NEED-TO-KNOW TECH NEWS

Monitors with stunning 360Hz refresh coming

DESTINED FOR ESPORTS PROS, MOSTLY.

We were already scratching our heads at 300Hz laptop displays from Acer and Asus, but now Asus is taking things to another level. Alongside Nvidia, it has announced the Asus ROG Swift 360 monitor that has an unprecedented 360Hz refresh rate. The monitor will target professional eSports gamers when it arrives later this year. An Nvidia spokesperson told us competitive players can expect a 4% improvement in flick shot aiming tests.

IMAGE: LEGIT REVIEWS

Intel has PCIe 4.0 Optane SSDs ready

BUT NOTHING FOR CUSTOMERS TO PLUG THEM INTO.

Intel's Technical Marketing Performance Engineer Frank Ober recently posted to Twitter the unannounced information that the Alder Stream next-gen Optane SSDs would support the PCIe Gen 4.0 interface. There's only one problem: Intel doesn't have any PCIe 4.0-capable CPUs available on the market for its customers to plug the drives into. However, it does provide some insight into Intel's future consumer Optane plans.

Intel reveals Horseshoe Bend

A BIZARRE CONCEPT WITH A FOLDABLE 17-INCH OLED DISPLAY.

Intel showed off the first foldable device with a 17-inch display at CES 2020. Named Horseshoe Bend, the latest Project Athena device runs on Intel's new Tiger Lake platform. The device is similar to Lenovo's ThinkPad X1 Fold in that it lets you view content on a full-sized panel or two separate displays when folded. When closed, the device has the same footprint as a 13.3-inch laptop.

IMAGE: SLON.PICS

China orders ban on all foreign hardware and software for government PCs

THE COUNTRY HAS THREE YEARS TO PURGE 20-30 MILLION PCS OF WESTERN PRODUCTS.

According to a report from the *Financial Times*, the Chinese government has ordered a total ban on all foreign PC hardware and operating systems in government computers. That includes graphics cards and processors from companies like Nvidia, AMD, and Intel, and operating systems from Microsoft and Apple, among many other US and European-based PC hardware and software manufactures.

Supposedly, the plan is to replace 30 percent of PCs and software by the end of 2020, 80 percent in 2021, and then 100 percent by 2022. This extreme move comes on the heels of the US banning Chinese company Huawei, as well as the US taking steps to deny China access to US technology.

Chinese companies have been preparing for what seems like an inevitability for years, but its hardware and software products have had only incubatory time in development and production compared to the decades of refinement that US companies have had. Doing away with Windows alone is an enormous shift.

Google Assistant receives an 'Interpreter Mode' for global translations

LIVE TRANSLATE FROM DOZENS OF LANGUAGES.

Google has announced that it has updated Google Assistant with the ability to offer real-time translation services in 29 different languages by just using a Nest Hub. It's not hard to see the value in such a service. Language barriers can make even the simplest conversations frustrating – and that's before money gets involved. Allowing people to communicate in their native tongue should help ease a bit of that tension, especially at hotels, airports and banks.

This new interpreter mode also brings the Nest Hub out of people's homes and into their businesses. The device is currently marketed as a digital picture frame that can adapt to its environment and offer easy access to Google Assistant for basic tasks. Google said in the announcement that the new mode will be put to the test right away, too, by launching in numerous locations across several industries, including various airports, airport lounges, banks, live sport events, humanitarian organisations, hospitality, and hotels.

acer

NITRO 5

Nitro powered by Intel®.
Play like the Pros.

Specifications may vary depending on model and/or region.
All models subject to availability.

NITRO 5

Combined power and performance of a 9th Gen Intel® Core™ i7 processor and NVIDIA® GeForce® GTX 1650

SUPERCHARGED CONNECTIVITY & STREAMING

Control your network with Killer™ Ethernet E2500 and effortlessly stream with Gigabit Wi-Fi

VISUAL INTENSITY

Sharp, vibrant images of a 15.6" FHD IPS display with up to 144hz refresh rates

COOLNESS UNDER FIRE

Chill out with twin fans, Acer CoolBoost™ technology and a dual exhaust port design

Available now at

Harvey Norman · scorptec computers · PLE COMPUTERS · mwave.com.au · CENTRE COM · PC CASE GEAR · Umart

AMD rebrands FreeSync monitors to make it easier to pick the right display

THERE ARE NOW THREE CLEARLY DEFINED TIERS FOR FREESYNC MONITORS.

AMD's own brand of anti-stutter and anti-tear monitor tech has been rebranded into three tiers – FreeSync, FreeSync Premium, and FreeSync Premium Pro. While the base tier remains the same, Premium promises at least a 120Hz refresh rate (at a minimum of Full HD resolution) with low frame rate compensation (LFC), while the Pro tier also includes HDR support on top of all this.

Sonos is suing Google for allegedly stealing its multi-room speaker secret sauce

AND AMAZON MAY BE NEXT ON SONOS'S HIT LIST.

Sonos is alleging that Google has ripped off its patented speaker technology, while using its scale to anti-competitively undercut the price of Sonos products, filing two lawsuits concerning five patents, and is also requesting a sales ban on a wide range of Google products. Sonos claims similar violations from Amazon, but doesn't have the resources to be "battling two tech giants in court at once".

Asus claims it has the world's most powerful 14-inch gaming notebook

INTRODUCING THE ZEPHYRUS G14.

Asus launched the Zephyrus G14 at CES, and it comes packing up to an AMD Ryzen 4800HS CPU with 8-cores and 16-threads paired with up to an Nvidia GeForce RTX 2060 GPU and up to 16GB of RAM. It's 14-inch display can be configured with either a Full HD resolution and 120Hz refresh rate, or a 2,560 x 1,440 resolution and 60Hz refresh rate, and the lid has an embedded dot matrix display.

AMD Ryzen 4000 Mobile APUs launched

7NM, 8-CORE ON BOTH 15W AND 45W, COMING Q1.

At CES AMD showed off its strategy for the new 7nm 4000-series of Ryzen APUs (AMD's term for a CPU with integrated graphics) for the first time in the mobile space. There's a tonne of options on the table, both at 15W and 45W, offering some really impressive core counts, frequencies, and most importantly, design wins.

For the new Ryzen 4000 series, codenamed Renoir, it's a fully integrated monolithic piece of 7nm silicon, containing eight Zen 2 cores and up to eight compute units of enhanced Vega graphics. That's twice the core count of the previous generation Ryzen Mobile, but three fewer compute units – however AMD has reasons for that decrease and emphasised that due to the process node it can get eight CUs to perform better than 11 CUs.

AMD is going to be launching two variants of Ryzen Mobile 4000, based around two power points. These will both be based on the same eight-core silicon, and be separated into 15W hardware, traditionally called the U series, and 45W hardware, traditionally called the H series.

AMD RYZEN 4000 15W U-SERIES CPUS

	CORES THREADS	BASE FREQ	TURBO FREQ	L2	L3	COMPUTE UNITS	IGP FREQ
RYZEN 7 4800U	8C/16T	1,800	4,200	4MB	8MB	8	1,750
RYZEN 7 4700U	8C/8T	2,000	4,100	4MB	8MB	7	1,600
RYZEN 5 4600U	6C/12T	2,100	4,000	3MB	8MB	6	1,500
RYZEN 5 4500U	6C/6T	2,300	4,000	3MB	8MB	6	1,500
RYZEN 3 4300U	4C/4T	2,700	3,700	2MB	4MB	5	1,400

AMD RYZEN 4000 45W H-SERIES CPUS

	CORES THREADS	BASE FREQ	TURBO FREQ	L2	L3	COMPUTE UNITS	IGP FREQ	TDP
RYZEN 7 4800H	8C/16T	2,900	4,200	4MB	8MB	7	1,600	45W
RYZEN 7 4800HS	8C/16T	2,900	4,200	4MB	8MB	7	1,600	35W
RYZEN 5 4600H	6C/12T	3,000	4,000	3MB	8MB	6	1,500	45W

80% of Australians used the internet every day in 2019

ESET CYBER AWARENESS SURVEY SHOWS SOME INTERESTING DATA FOR AUSSIES.

Online security and antivirus company, ESET, has released its annual report on the online and tech-related behaviour of Aussies for 2019. The survey covered more than 1,000 individuals, so it's better to treat it as indicative than concrete, but some of the results are certainly interesting. Of the Australian population, 87% were internet users, and 93% of these users would access the internet every single day.

As for device usage, 92% of those surveyed used a smartphone and 72% used a laptop, while less than half (48%) used a desktop computer. Android dominated Apple in the smartphone realm, with more than 20% lead in the market, while almost exactly the reverse was true for tablets as the iPad reigned supreme. Windows held a meagre 2% and 7% usage in those two domains respectively, but it still comfortably rules the laptop and desktop domain, with a 77% and 85% take respectively. Only 21% and 13% of laptop and desktop users (respectively) chose Apple products.

SONY

α ALPHA

ONE MOUNT

LENSES FOR LIFE

Upgrading your camera shouldn't mean throwing away your lenses.
With one mount standard across the Sony Alpha range, you'll never leave a lens you love behind.

sony.com.au/mirrorless

THE LEADER IN MIRRORLESS

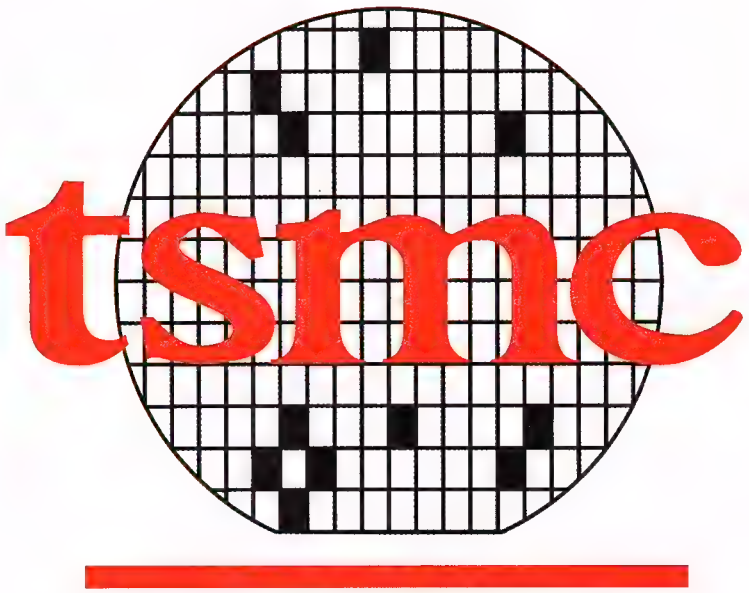
ONE MOUNT

techbrief

» A DEEPER LOOK WHAT'S TRENDING IN TECH.

TSMC's 5nm process is making big progress

Reportedly already at 50% yield.



The *China Times* reports that TSMC's upcoming 5nm process has already hit yields of 50%, meaning 50% of all processors yielded on a 5nm wafer are fully functional. The report also specifies that AMD's Zen 4 architecture will be fabbed on the 5nm process.

Although the yield rates have reportedly reached 50%, the other 50% of these dies are not totally broken but can be salvaged as processors with fewer cores enabled, for example. TSMC's 5nm is also entering risk production, which includes the very first wave of products that are expected to help iron out any kinks so TSMC can bring all of its 5nm capacity fully online.

The new 5nm node reportedly brings a 1.8x greater density over 7nm and 15% higher clock speeds at the same power, or reduce power consumption by 30% (meaning processor designers will have to choose one or a blend of both). This is not quite as good as the jump from 16nm to 7nm was, but as many are aware, silicon is reaching its limits rather soon, and we should expect density and power efficiency gains to slow down a little.

Two new processors, Apple's A14 and Hisilicon's new Kirin processor, have reportedly already been taped out on 5nm. The chips will supposedly be mass-produced in July. The *China Times* also points out AMD's Zen 4 CPUs will be based on 5nm. The node almost doubles density, so perhaps we might see a doubling in core count, though a 50% increase is more likely because 1.8x isn't quite 2x.

Zen 4 is, of course, quite a ways off, expected in 2021 at the earliest, and possibly even 2022. Since it is on a brand new node, it's easy to expect we will see some packaging difference between it and Zen 2/3. Perhaps AMD will increase the number of cores per die, or increase the number of dies and keep them all at eight cores each.

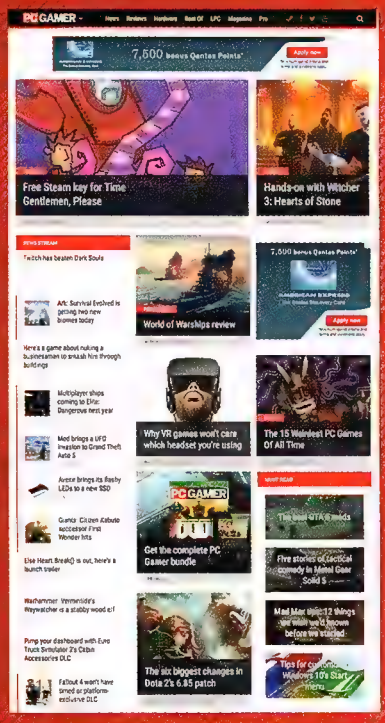
Meanwhile, Samsung and Intel (TSMC's only real competition), have been struggling to get out new nodes. Intel suffers the most and is still on its 2014 14nm process for the vast majority of its CPUs because its 10nm development was extremely troubled. Intel's 10nm process is finally live but the company only uses it for a handful of laptop CPUs, likely due to supply constraints.

Samsung is apparently going to manufacture Nvidia's upcoming 7nm GPUs, but that remains to be seen. It's not clear how well Samsung's 7nm process compares to TSMC's. TSMC certainly seems like the obvious winner today, but Intel isn't out of the race quite yet, as its highly anticipated 7nm process could bring the company back into the forefront of CPU manufacturing.

We can likely expect any processor sporting TSMC's upcoming 5nm process to be significantly ahead of any chip on an older process, though the lead won't be quite as pronounced as it used to be between a new node and an old node. Because of this, we can also expect that 5nm capacity will be in high demand just as 7nm is, so hopefully, TSMC has enough supply for the whole world to share. ■

"The new 5nm node reportedly brings a 1.8x greater density over 7nm and 15% higher clock speeds at the same power, or reduce power consumption by 30% (meaning processor designers will have to choose one or a blend of both)."

SMARTER COOKIES ENABLED


PC GAMER
7,500 bonus Qantas Points*
Apply now
Free Steam key for Time Gentlemen, Please
Hands-on with Witcher 3: Hearts of Stone
NEWS STREAM
Twitch has beaten Dark Souls
ARK: Survival Evolved is getting two new biomes today
World of Warships review
Here's a game about nuking a businessman to smash him through buildings
Multiplayer shoot coming to Elite: Dangerous next year
Mod brings a UFO invasion to Grand Theft Auto 5
Why VR games won't care which headset you're using
The 15 Weirdest PC Games Of All Time
Avenir brings its flashy LEDs to a new SSD
Get the complete PC Gamer bundle
Elite Heart Break() is out, here's a launch trailer
Warhammer Vermintide's Waywatcher is a stabby wood elf
The six biggest changes in Dota 2's 6.85 patch
Pump your dashboard with Euro Truck Simulator 2's Cabin Accessories DLC
Fallout 4 won't have timed or platform-exclusive DLC

JOIN US ONLINE AT
WWW.PCGAMER.COM

gadgets

» GIZMOS AND GOODIES.

SEGA MEGA DRIVE MINI

$99 | MEGADRIVEMINI.SEGA.COM

We like this new trend of miniaturised retro tech. Now that we're bored with last year's little PlayStation Classic, this comes along to sit alongside it and refresh our retro love, and it's official from Sega. Perfect. Importantly, there's two control pads – and they're modelled on the originals, too. They feel kind of the same to use – as far as we can remember that far back. There's 42 games built into it, and that's all you're getting, so your hundreds-strong collection of game ROMs on your PC does win in maths terms, but this is real Sega, looks and feels the part, and is a joyous thing to plug into your TV via a fancy high tech HDMI cable.

RAZER ERACING SIMULATOR COCKPIT

$TBA | RAZER.COM

Ever-diversifying, the mouse and laptop company which last year announced it was making a toaster (!), has announced at CES 2020 that it's got itself a very fancy sim racing rig, now. It's a super-premium unit, with components from partners Simpit and Fanatec – both well established leaders in sim racing. Built atop a hydraulic motion platform, it also includes a seatbelt tensioning system that simulates braking forces. Razer's talking about putting these in esports tournaments, and given how strongly the sim racing scene is growing, it could one day be a product you can purchase.

LOGITECH MX KEYS

$199.95|| LOGITECH.COM

If you're looking for a platform-agnostic Bluetooth keyboard for professional work, then Logitech's Master series has been the range to beat for some years now. The MX Keys low-profile keyboard is the latest to join the range, maintaining Logitech's multi computer Flow connectivity for simple switching between three devices. Considering it sits just 2cm off the table, the keys offer a nice amount of travel that is really comfortable over long typing sessions. The keyboard is surrounded by a premium looking metal keyboard surround and the USB-C charging cable delivers 10 days charge (or five months if you turn off the keyboard backlighting).

KATSURU BETA

USD $2,499 | KATSURU.AI

What happens when you pair a Russian drone startup with a celebrated New York graffiti artist? Some might say vandalism, but others will say artistic revolution. Whatever your skew, the semi-autonomous spray paint carrying drone is pretty impressive from a technological perspective. While it's still likely loud enough to set your neighbours dog into a barking fit, this flying spray can apparently senses how close it is to the wall, giving you precise control over the strokes you can take with it. We imagine there's a bit of a learning curve, but it has to be safer than actually scaling a tall building to leave your mark.

RAZER KISHI

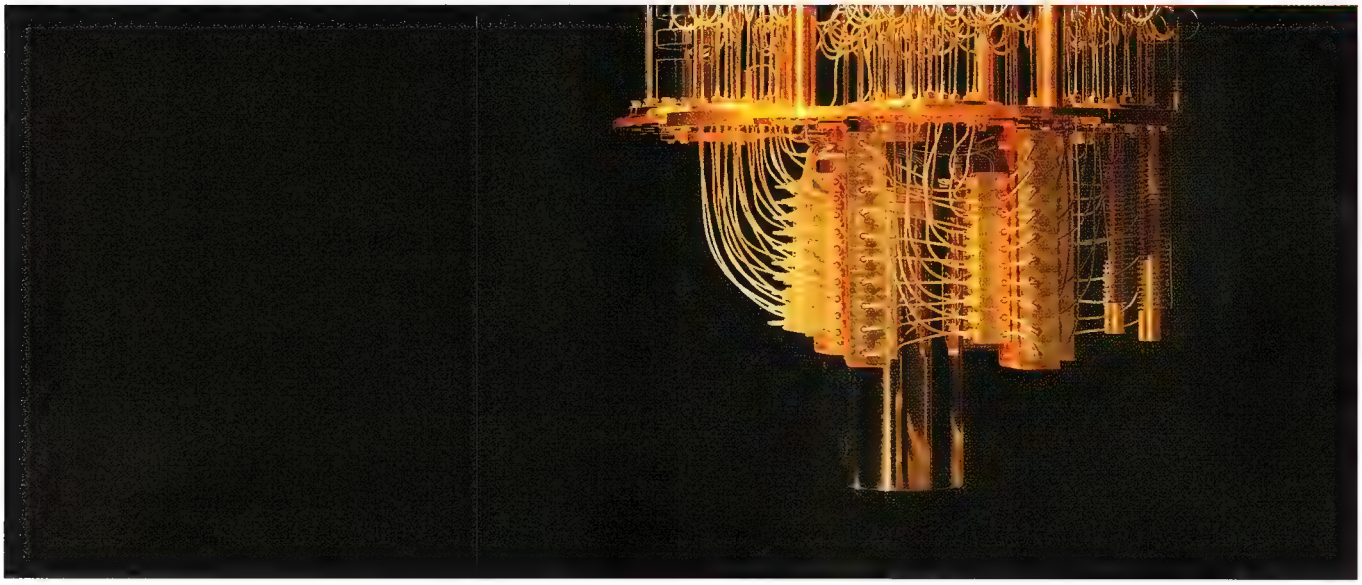
$TBC | RAZER.COM

The Nintendo Switch is an awesome console, but most of us have a powerful smartphone already in our pocket and it seems a shame to not make the most of its gaming powers. The Kihsi from Razer hopes to fix that by adding two Joy-Con like controllers to either side of your Android or iOS device so you can game with what you already have. The controllers are built with premium finishes and use lightning/USB-C connections for low latency input. The Razer Kishi is an interesting proposition as more game streaming services come online this year.

PANASONIC VR GLASSES

$TBC | PANASONIC.COM

If steampunk is your beat, then Panasonic's latest VR headset is sure to get those engines boiling. A bit more cutting edge than your average 1920s driving goggles, Panasonic's headset contains a pair of micro OLED panels that offer HDR colour and refresh at 120Hz to keep you from feeling woozy. These visuals are paired with earbuds driven by Panasonic's famed audio brand Technics, which are also designed for low latency response times. At the moment these goggles are still in the concept stage so they may never make it to consumer release, but we can always hope.



The 2020s will see the rise of the quantum computer

And it will change everything, says Chris Szewczyk.

Revolutionary is a word that often gets overused. I've been guilty of it myself. But if there's one thing in the world of computing that deserves being described as such, it's a fully functional quantum computer.

What is a quantum computer? The functions of a classical computer are based around the use of bits, or binary digits which are 1s or 0s. A quantum bit, or a qubit as it's known, can exist as a 1 or 0, or *both at the same time*. A sufficiently powerful quantum computer can potentially make use of thousands or more qubits to perform calculations that are simply impossible on any classical computer, no matter how powerful it is. The physics challenges are being ticked off at an increasing rate, and we are moving into the realm of the engineering challenges. Several companies have low level functional quantum computers already. In fact Google claims that its 53-qubit processor was able to perform a task in 200 seconds that would take thousands of years on a classical supercomputer.

What kinds of tasks will a quantum computer be used for? The early applications seem to be related towards materials science and molecular analysis. This means things like improved drugs, battery technology, climate analysis and forecasting. How does managing Sydney's traffic sound?

While I'd like to focus on noble causes and ways that QC's can benefit humankind, QCs may end up being developed firstly as instruments of digital warfare and espionage, much like early classical computers were. Much of the work on quantum computers is taking place in secret by the governments of the world. It's something of an arms race. China has already invested billions of dollars into its quantum research programs and indications are that alarm bells are ringing inside the US government, where national security means everything. US agencies fear they might be left behind on the developing digital battlefield.

A quantum computer is uniquely capable of making many widely used encryption standards obsolete. Your online banking? Passwords? How about bitcoin? A QC could theoretically crack Satoshi's private keys and access that long dormant one million coins. All that sounds dramatic, though thankfully a lot of the world's infrastructure can be upgraded with quantum secure encryption. But, consider the fact that the likes of the Chinese government is unlikely to want to show its hand. A black swan event could come and go and the public wouldn't even know about it. Let's hope those nuclear codes are secure!

We may be many years away from a seeing a genuine and stable high qubit count quantum computer, and decades away from home use (if ever) but there is no doubt at all that quantum computing promises to provide unprecedented levels of computing power. Will we see it come to the fore this decade? The way the pace of development is increasing, it's likely that something world-changing is coming. Let's hope the technology is used for the benefit of all, and not just more warfare and espionage. Who knows, maybe by 2030 we'll get 120fps at 4K from *Metro: Exodus*! ■

"China has already invested billions of dollars into its quantum research."

Moderating content for Google or Facebook is dangerous and dangerously underpaid

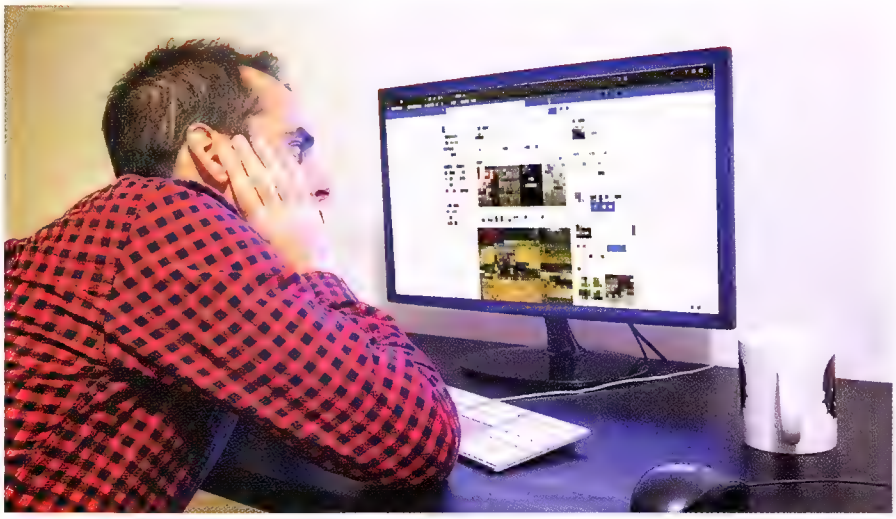
Workers on the frontline of online hate and toxicity need more support, writes Shaun Prescott.

Given how often we hear reports about Google and Facebook's efforts to finetune its moderation algorithms, it's easy to forget that there's a growing global workforce of actual people tasked with rifling social media for objectionable material. The nature of this content varies dramatically, ranging from the fairly benign (copyright claims) through to the despair-inducing (violence and abuse).

The Verge issued a number of reports throughout 2019 tackling the subject. One former employee at Google reports having suffered post-traumatic stress disorder after being tasked with vetting material flagged as containing child abuse. Whether employed by Google (or Facebook) directly, or working under a contractor (companies like Accenture and Cognizant), the cumulative impression is that people are being employed for work that is probably better left to, say, the police, or any other professional better equipped to deal with exposure to traumatic material.

Stress, social withdrawal, depression, unhealthy and rapid weight gain… these are some of the symptoms suffered by the people *The Verge* spoke to. In a separate report on *The Guardian* last year, contractors moderating on behalf of Facebook pointed to some fellow employees becoming addicted to objectionable graphic content. One former employee told the *Wall Street Journal* that content moderation is "the worst job in technology".

So what can be done? Facebook and Google love apportioning blame to algorithms, but no matter how widely they're currently used, or how



effectively, it doesn't seem feasible that the human cost of content moderation will go away anytime soon.

In February 2019, an Australian terrorist murdered 51 people and injured 49 during a gun attack on the al Noor Mosque in Christchurch. The terrorist livestreamed footage of the atrocity on Facebook, and while the video was eventually removed, it didn't stop an influx of versions arriving on YouTube in the hours after the attack, nor animated gifs appearing on Twitter, nor can it eliminate the versions of the video still available online.

The only way to stop this happening again is to dramatically reconfigure what social media actually is – to eliminate the spread of objectionable material, platform holders would need to vet every piece of incoming content before it is published. This obviously flies in the face of what social media actually is.

But is social media worth saving? Given that it's main commercial goal is to pillage our behavioral data in order to sell things to us, it's easy to take a burn-it-to-the-ground approach. But for every abuse of these platforms there are countless examples of how social media can be useful: see how communities can communicate and coordinate in the face of the bushfires, for example.

Whatever the case, content moderation is a difficult and potentially scarring task. While employees working directly for Google or Facebook report decent salaries, those working for contractors often work for barely above the minimum wage in the United States. That obviously needs to change: this is difficult, draining work and it's increasingly important. ■

Share your stories!

If you have an interesting story about technology users, their experiences and the issues that affect us all (whether funny or serious), email us at **apcmag@futurenet.com**. All correspondence becomes the property of *APC* and is subject to editing. Letters must include writer's full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.

Ring Camera locations in the U.S.

Includes every camera that posted to the Ring Neighbors app since November 2016

Being watched

Joel Burgess examines the string of security questions around Amazon's home security software, to see who is safe.

A string of reports concerning the exposure of thousands of Ring user account names and passwords appeared online in December, followed by some sobering videos of hackers speaking to young children through the camera's two-way talk functionality. *BuzzFeed* was the first to report on a 3,672 item long list of breached accounts, including both log-in emails and passwords that could give hackers access to everything from telephone information to full access to historical and current camera feeds. In a response to the publication, Ring stated that the data did not come from a breach of Ring's systems, and that the list may be compiled from the security breaches of other companies where the users have the same log-in credentials. It is, however, a strange response given the list contained the camera names and time zones of Ring users, information that could not come from outside sources.

Just before Christmas *TechCrunch* found a subsequent list of 1,562 unique login credentials circulating a dark web messaging site that appeared to have similar details to the original list. In response to the numerous credential leaks *Motherboard* did a security audit on Ring's video security system. It wasn't good. In addition to not encouraging two-factor authentication, Ring also had no protocol for checking the authenticity of first time logins from new IP addresses and allows numerous people to be logged in to the online account concurrently. It also doesn't flag IP addresses as suspicious or attempt to block a device if it enters the wrong password multiple times, a pretty standard security practice to make it more difficult for bots or hackers to infiltrate accounts.

Considering the Ring security cameras are often in sensitive areas, such as bedrooms, the number of security protocols adopted by the Amazon-owned company is surprisingly few. If the risks of this weren't abundantly clear already, the recent data breaches are believed to be linked to reports of Ring cameras being used to yell at sleeping residents, demand a bitcoin ransom and provide the backdrop of a hacker's live stream video. These recent hacks are the most dramatic instance of misuse we've seen, but there have been ongoing concerns with an audit by Mozilla in November finding that the company does not encrypt video feeds and the accusations from earlier in the year that Ring let employees view and share the video files of its users, whether they needed access to the videos to complete their duties or not.

While in the wrong hands the potential for misuse of these devices is high, you probably don't want footage of your house's interior in anyone's hands. Yet Ring doesn't seem to share those concerns since this year it has also struck up arrangements with over 400 local US police agencies, to streamline the sharing of video footage.

Opposition to the mass network of surveillance have raised concerns over the lack of transparency concerning the arrangements and the potential for misuse. While the products are decent from a technical perspective, you might want to consider upping your security if you're going to trust Amazon with your security videos. ■

numbercrunch

» WE LOOK AT THE NUMBERS DRIVING THE BIG TECH NEWS.

3,000 METRES

Is the height a 4G-enabled Panasonic Toughbook, tethered to a balloon, rose to before losing connectivity. This essential research was carried out by Panasonic, Netmotion and Microsoft, and eventually saw the lofty laptop reach 30,000m, where the balloon exploded. It landed in the countryside, apparently unscathed.

$49BN

Is how much Xerox has bid to buy HP. The bid was rejected, with HP's board saying it "significantly undervalued" the business.

65%

Is the proportion of internet users using the Chrome browser in October 2019. Safari comes second on 16%, with Firefox third on 4.3%.

1,010KPH

Is the speed Bloodhound LSR, a car powered by a Eurofighter jet engine, achieved in testing on the Hakskeenpan, in the Kalahari desert, this month. The team hopes to break the land speed record of 1,228kph.

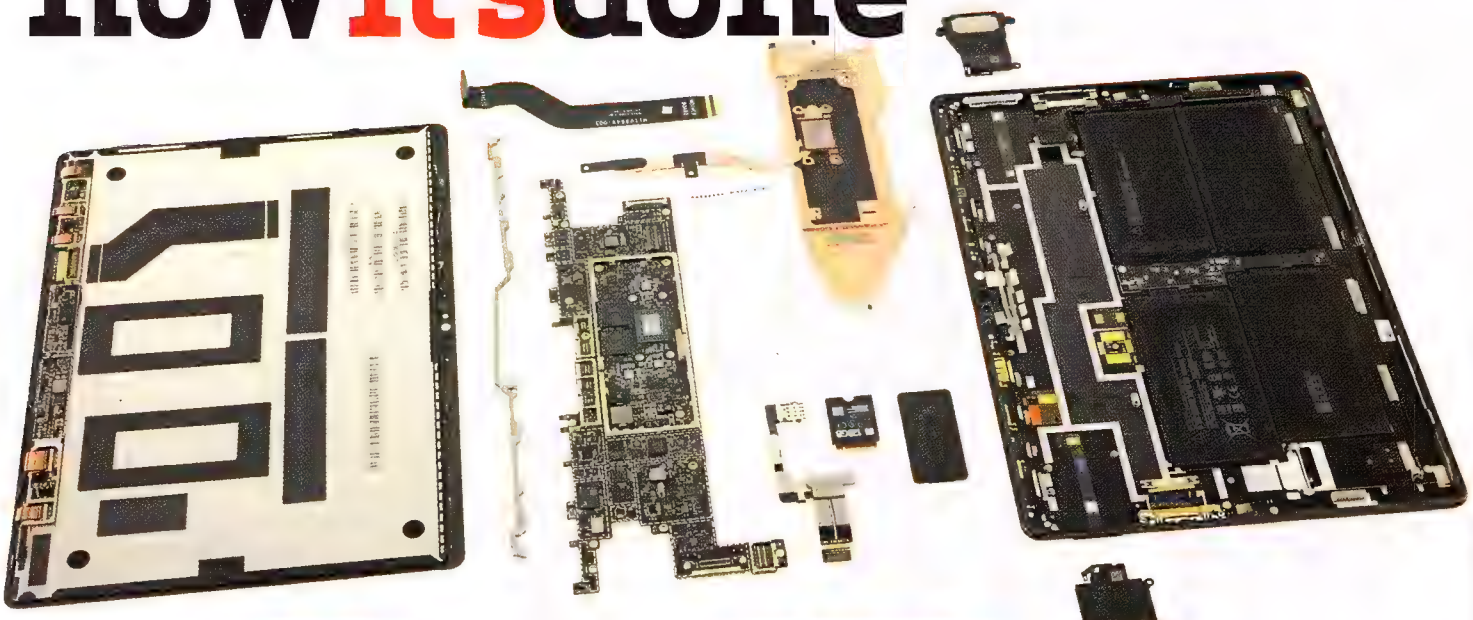
$292M

Is the amount venture capital company Accel has invested in 1Password. The password management company, founded in 2005, has never received outside investment before.

1,000 PETAFLOPS

Is the slightly baffling way the US government, Cray and Intel are describing their latest joint venture, the Aurora supercomputer. A FLOP is a measure of computing power that counts floating point operations per second, and peta is what comes after giga and tera – a thousand million million. This many FLOPS is enabled by lots of Intel CPUs and GPUs, and the supercomputer will be the most powerful in the world when it launches in 2021.

howit'sdone



This SSD looks super-familiar. A quick comparison with the 256GB drive we pulled from the Surface Laptop 3 confirms both devices are using the same drive. Standardisation is great for repairs!

The screen comes clear with some serious suction, but we didn't have to reach for the heat gun, which is a bonus.

Microsoft Surface Pro X

X marks the spot, so let's start digging!

Less than a month after dropping the Surface Pro 7, Microsoft is back with the Surface Pro X – a fresh design with hints of improved repairability. Since ripping into the Surface Laptop 3, we're cautiously optimistic. Bring on the era of repairable tablets, Microsoft – we're ready.

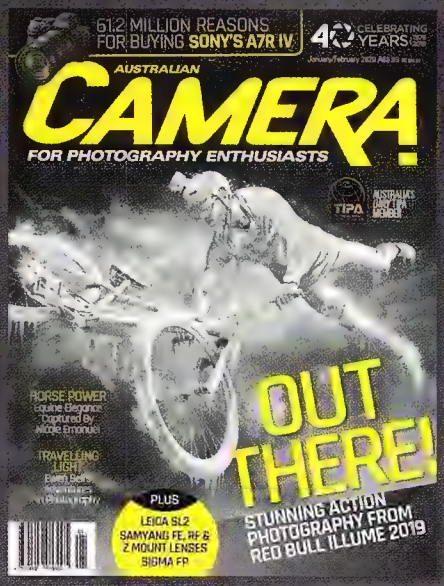
MAJOR TECH SPECS

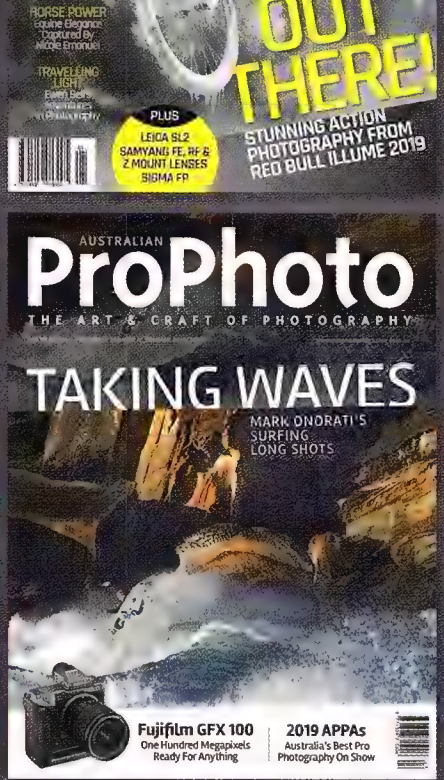
- 13-inch PixelSense 2880x1920 display (267ppi)
- Microsoft SQ1 3.0GHz ARM CPU (based on Qualcomm's Snapdragon 8cx), with a Microsoft SQ1 Adreno 685 GPU
- 8GB of LPDDR4X RAM (16GB optional)
- Removable 128GB SSD (256GB or 512GB optional)
- 5MP and Windows Hello front-facing cameras, and 10MP rear-facing camera
- 2x USB-C ports and one Surface Connect port
- Wi-Fi 5 802.11ac, Bluetooth 5.0, Gigabit LTE

KEY FINDINGS

- Unlike the Surface Pro 7, the Pro X is a complete redesign. Compared to the Pro 7, we note the Pro X's rounded corners, narrower profile, and reduced port selection.
- With the kickstands raised, we can see that the Pro X gets a sleeker hinge, and there's the faint outline of what can only be described as a secret trap door. Beneath, an SSD (held down by a T3 screw), and a SIM slot. The SSD looks familiar. A comparison with the 256GB drive we pulled from the Surface Laptop 3 confirms both devices use the same drive. Unlike the Laptop 3 with its hidden screws, we don't find any fasteners lurking under the kickstand.
- We try a little suction to lift the display near the speaker grille, and we can cut right in. No goopy tendrils hold this display down – it comes off clean. This friendly, cuttable foam adhesive is an improvement over other Surface Pros, and pretty much all tablets with glued-down screens.
- We need only a single Torx bit to twirl away the heatsink screws. Here's one thing we're glad Microsoft didn't change: All the screws so far are just Torx. That was the previous Surface Pro's sole positive repairability point, and it's good to see it return. Supporting the heatsink is an interesting bit of abstract art. With the heatsink and quite a few shields and screws out of the way, the motherboard slides out.
- It seems that Microsoft has placed at least one foot on the repairability train – between this Pro X and the Laptop 3, we can hardly believe all the repair-focused changes it has made. The SSD is truly user-replaceable, requiring only a SIM eject pin and a T3 driver – no need to remove the screen. That's awesome to see in such a slim form factor. As a bonus, it's the same SSD as in the Laptop 3, so more standardisation and better support from third parties.
- Repairability Score: 6 out of 10 (10 is easiest to repair). The user-removable SSD makes for easy upgrades and data security that doesn't require device destruction. To the extent that screws are used, they are all standard Torx fasteners. Many components are modular and can be replaced independently. Almost all repairs require display removal, with an improved procedure that needs no heat, but necessitates careful prying. The battery is glued in place, with its connector pinned under the motherboard – requiring near-total disassembly for service. ■

THE FUTURE OF TECH MAGAZINES





Subscribe at **www.techmags.com.au**

Ryzen 3 3200G vs. Core i3-9100 vs. Athlon 3000G

This month, we're turning our heads to accelerated processing units. AMD is killing it at the moment on the integrated graphics front, although Intel's APUs – such as the Core i3-9100 – are still top-notch products. If you're looking for a processor to power a budget build, there are plenty of options on the market right now. The Intel versus AMD debate may rage until the end of time, but AMD has given its budget Ryzen 3 3200G APU an extra competitor in the frighteningly cheap Athlon 3000G. Can this affordable underdog take home the crown?

1 Value

This is tough. In terms of baseline pricing, the Athlon 3000G should win this round; it's $79, for crying out loud. There's no buying integrated graphics processors with that kind of money, other than the old Celeron and Pentium APUs from Intel that aren't supported on current-gen mobos. The 3000G does sit beneath AMD's other APUs in terms of processing power and features, though. The Intel Core i3-9100 offers a maximum of 16 PCIe lanes and 50 percent more cache memory, while the Ryzen 3 3200G has the fastest memory support: 2,933MHz as opposed to the 9100's 2,400MHz and the 3000G's 2,667MHz.

All three come with an air cooler unit, although Intel's included coolers aren't that impressive. The AMD chips come with the excellent Wraith coolers, which are a good addition to improve the value. The i3-9100 is the most expensive chip by far, costing $199 at the time of writing; more than twice the price of the Athlon 3000G. Meanwhile, the 3200G costs around $140, which is a perfectly reasonable amount to spend on an APU, but at close to double the price, it doesn't double the baseline performance of the Athlon, so we're giving the win here to the 3000G.

WINNER: ATHLON 3000G

2 Performance

Shockingly, the super-budget Athlon doesn't win this round. Granted, it's the only chip here with multithreading, bringing its thread count to four; tied with the other two, despite only having two cores. It can't quite match the higher frequencies and superior integrated graphics of the other two. The i3-9100 does well – in CPU-bound tests it outpaces the Ryzen 3 3200G by a small margin (less than 10 percent). However, the 3200G's integrated graphics are better suited to low-end gaming than the i3-9100. It's a case of Radeon Vega 8 against Intel UHD 630, and AMD has a slight edge when rendering graphics in real time.

Neither chip is going to perform outstandingly without a discrete GPU, but the 3200G can carry most games in 720p and even some at 1080p. In our recent budget build, we saw the 3200G play Rise of the Tomb Raider at 1080p ultra, with a frame rate almost triple that of the i3-9100. There's no contest in terms of graphical power; the Intel chip is a bit older than the Ryzen, too, utilising the same integrated graphics as the older i3-8100. So, we lean toward AMD, but once desktop models of Intel CPUs featuring the Iris Plus graphics arrive, our tune may change.

WINNER: RYZEN 3 3200G

3 Efficiency

APUs tend to have broadly comparable power consumption, with the graphics demanding a bit more juice than conventional CPUs. The Ryzen 3 3200G and Core i3-9100 are both rated for a TDP of 65W, the same as more powerful chips without integrated graphics, such as the Ryzen 5 3600. But Intel and AMD calculate TDP differently, so without getting too deep into the math, the Ryzen chip likely uses slightly less power. The Athlon 3000G, however, has a far lower default TDP of 35W.

Looking at clock speeds, the Ryzen and Core both exceed the Athlon, but when comparing base clocks against TDP, the 3000G comes out on top. Core processors still use less power than many other components (such as GPUs), and overclocking means that power consumption in APUs is potentially variable. None of these chips have brilliant overclocking potential anyway, so the winner here is the 3000G. Its Vega 3 graphics can give Intel's UHD 630 a run for its money, and utilising SMT means it packs the same number of threads as the other chips without overburdening your power consumption. If you're looking to build a low-power system, this is one of the best APUs around.

WINNER: ATHLON 3000G

"Just so we're clear, the i3-9100 is the better processor, but it sits almost in a different bracket to the Athlon 3000G."

From left to right:

The 3200G is currently the cheapest third-gen Ryzen chip.

Intel's Core i3-9100 is a more expensive but speedier APU.

This is AMD's newest, shiniest Athlon chip yet.

4

Overclocking

AMD's been having a hard time with overclocking. The Zen 2 Ryzen CPUs (3600 and up) have had serious issues with overclocking headroom, rarely able to hit their advertised boost clocks across multiple cores. The 3200G uses the 12nm Zen+ architecture, which is a bit more stable, but still isn't able to hit any particularly dizzying heights. The Athlon 3000G comes unlocked, using the even older 14nm Zen architecture, and is capable of boosting its 3.5GHz base clock up to 3.9GHz. That might not sound like much, but it's the same increase as the 3200G's theoretical base to boost clock.

Intel has the edge here, though, with the reliable Coffee Lake architecture capable of handling an overclock of up to 600MHz more than its base clock of 3.6GHz. It can do this easily in single cores, or a little less reliably across all cores. It still comfortably outperforms the other two in manual overclocking. With auto overclocking, the waters are muddied. AMD's Ryzen Master software gives the 3200G a slight edge, and does tend to improve performance by a reasonable amount. Overall, though, we'd have to give it to the Intel chip; the potential headroom for overclocking is simply greater.

WINNER: CORE I3-9100

5

Flexibility

All three chips can form a solid foundation for an upgradable custom system, and all are relatively new (the oldest, the Core i3-9100, is less than a year old). Longevity is to be expected from CPUs in this day and age, and each chip here presents that. Quad-core (or quad-thread, in the case of the 3000G) is enough to handle any ordinary work on a regular basis, and there's the potential to upgrade to a discrete GPU for more graphical oomf. But which of these chips best supports future upgrades and expansions?

The i3-9100 might not be the obvious answer; it has the slowest memory support, and its higher price makes it look more like a budget upgrade piece than an upgradable baseline. But it has more cache memory, a higher boost clock, and most importantly, it has more available PCI Express lanes, thanks to Intel graphics connecting differently. This leaves more support for upgrades; expansion cards, SSDs, whatever else you might want to add to a evolving build. There are a lot of factors at play here. If the AMD chips had support for PCIe 4.0 – currently an AMD-exclusive feature of Zen 2 – we might have changed our minds, but as it stands, we're giving the win to Intel.

WINNER: CORE I3-9100

And the winner is...

We're calling this one a tie. That's between AMD's Athlon 3000G and the Intel Core i3-9100; the Ryzen 3 3200G is a good low-end gaming APU, but it lacks the raw CPU performance of the i3-9100 or the exceptionally modest pricing of the 3000G. Just so we're clear, the i3-9100 is the better processor, but it sits almost in a different bracket to the Athlon 3000G. We included an Intel chip for variety, but it overpowers both of these AMD APUs; a more realistic comparison would be the excellent Ryzen 5 3400G.

The Athlon 3000G sits at the ultra-budget end, and we love it for that. It's almost hilariously affordable, and we can't wait to build with it. The low price makes it a great chip for budget systems, and we might even go so far as to recommend it for more esoteric purposes, such as CPU-bound cryptocurrency mining. It's worth noting that while the 3200G is the loser here, it's not a bad chip. All three of these are worthy APUs in their own rights; the real deciding factor for any prospective buyer should actually just be the price. ■

LAPTOP

FROM $3,799 | APPLE.COM/AU

Apple MacBook Pro 16

Apple has put a bigger screen on its much-loved 15-inch MacBook Pro, but does bigger always mean better?

The 15-inch laptop has long been the form factor of choice for professionals that need as much power as possible from a portable ultrabook, but Apple is looking to change this up with the new MacBook Pro 16 by adding an inch to this tried and tested form factor.

In reality, Apple is not actually making the footprint of the unit notably bigger – it's less than 2% larger in each direction – so you probably wouldn't see a difference unless you were really looking for it. What it has done, however, is reduce the bezels and expand the screen for a greater screen-to-body ratio and overall screen size. Considering the MacBook Pro 15 is pitched at creatives that want as much power as possible, it's only natural that those same users would want as much screen as possible – especially when it comes at no extra cost to the device's overall footprint.

When it comes to being the best on paper an inch is as good as a mile, but Apple seems to have put a lot of effort into genuinely improving the updated MacBook Pro offering. On the hardware side of things the first standout feature is a 35% larger heat sink and 28% more airflow for cooling, which should provide enough overhead to service the powerful Intel Core i9-9880H, or more than enough if you opt for the Core i7 variation.

Apple tends to service the elite end of the market already, but the bigger MacBook Pro variation has some pretty ludicrous upper limits when it comes to configurable specs with options ranging up to 64GB of RAM and an 8TB PCIe SSD. So your workflow and bank account will have to battle it out to find some acceptable middle ground.

CHOICE GALORE

For those looking at the more affordable end of the spectrum, units with a 9th-generation Intel Core i7-9750H CPU, AMD Radeon Pro 5300M GPU, 16GB of RAM and a 512GB PCIe connected SSD starts at $3,799. If you want one with the 2.4-4.8GHz Intel Core i9 model, the octa-core range starts at $4,399 for units with an AMD Radeon Pro 5500M, 16GB of RAM and 1TB of PCIe SSD storage, but you can overclock this CPU to 3.4-5GHz for an additional $320. We tested the Core i9 configuration with 32GB of RAM, an 8GB Radeon Pro 550M GPU and a 2TB SSD which has an RRP of $6,159.

The 16-inch Retina display is the biggest screen on a Mac notebook ever, so it's understandable why it is a headlining feature. This 3,072 by 1,920 pixel display sits somewhere between Quad HD and 4K in an aspect ratio that is closer to three by two than 16 by 9. This high resolution Retina display also offers a 500 nit peak brightness and a full P3 colour gamut that is ideal for video production and anything else that requires high dynamic range colour reproduction. Apple has worked on the display's oxide thin film transistor to

"When it comes to being the best on paper an inch is as good as a mile, Apple seem to have put a lot of effort into genuinely improving the updated MacBook Pro offering."

improve colour uniformity and battery draw from earlier MacBook Pro displays, and when everything's taken together, the screen becomes an ideal workspace for creatives that need to work on-the-go.

BIG CPU AND GPU JUMP

Apple is claiming that the new Core i9 CPU makes the MacBook Pro twice as fast as former quad-core MacBook Pros in software like MATLAB, Blackmagic Fusion Studio and Autodesk Maya. Against the 2019 hexa-core i7 MacBook Pro 15 this equates to a 40% bump in Cinebench R20 CPU scores and it lands within 6% of the Gigabyte Aero 17 which uses a similar Intel Core i9-9980HK CPU. This is a serious amount of processing power that would outpace many desktop units.

While the CPU is undoubtedly impressive, the graphical performance of the MacBook Pro 16 is even bigger, doubling the Compute performance on Geekbench 4 of the MacBook Pro 15 which used an AMD Radeon Pro 555X. While this GPU is definitely a big step forward, the Radeon Pro 550M (8GB) only achieves about half of the performance as laptops that use a Nvidia GeForce GTX 2070 in the same benchmark, so if your workflow is primarily graphically intensive you can do a little better.

The Core i9 variant comes with 1TB of PCIe SSD storage as standard, a factor that actually makes it competitively priced against the few other players in the performance ultrabook space – something we don't often say about Apple products. We pegged this SSD with read and write speeds of 2,875MB/s and 2,630MB/s respectively, which is on par with most of the good NVMe SSDs out there.

AS BEAUTIFUL AS EVER

While the core functionality of the computer is the most important element of a good PC for us, the appeal of something that looks good is hard to quantify and the MacBook Pro 16's clean in-line keyboard surround speaker grills, generously-sized trackpad and simple unibody design makes it a standout aesthetically. These features don't just look good, however, the six speaker sound system has actually been reengineered to deliver bigger bass that reduces rattle by using an inverted woofer array and also offers impressive digital Dolby Atmos surround sound. That oversized trackpad is as smooth and easy to use as ever, and the keyboard has returned to an earlier Magic keyboard design with a physical escape key thanks to popular demand.

Where Apple really hopes to distinguish itself is with the integration of software and hardware. This synergy is easily expressed in the Touch Bar, which is included as stock on both variants of the MacBook Pro 16. Apple has at least 24 key apps that include touch bar integration which allows power users to get that little bit extra productivity out of anything from Excel to Final Cut Pro.

To round out what is a really impressive feature list is a 100Wh Lithium polymer battery that Apple claims gives you 11 hours of web browsing or movie playback, which is an impressive feat for a device this powerful. By comparison the similar Gigabyte Aero 17 only manages to last three hours and 45 minutes in our 1080p movie playback test, despite having a similar 94Wh battery.

Apple seem to have conceded on a few divisive issues with earlier MacBook Pro models while at the same time taking big strides in graphics, thermal and battery life performance – all while increasing the screen size and keeping the price in check. ■

Joel Burgess

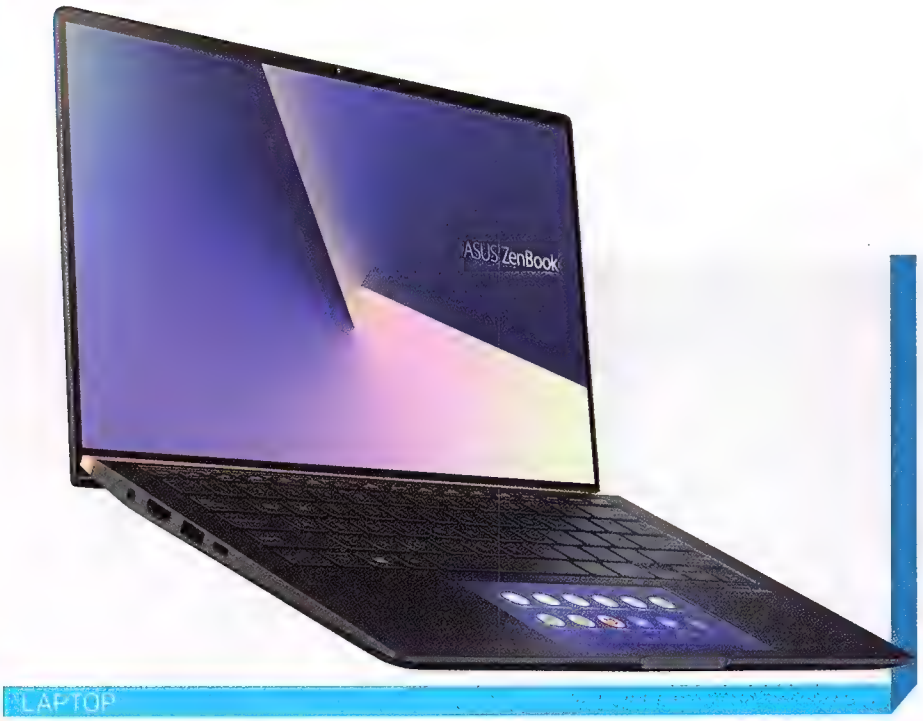
Verdict

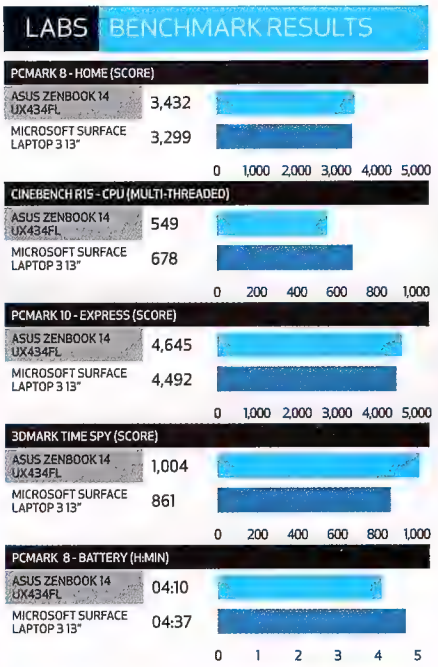
A nice update that increases screen size, improves speeds and extends battery life.

★★★★★

BENCHMARK RESULTS

	GEEKBENCH 4 - MULTI-CORE CPU (SCORE)	CINEBENCH R20 - CPU (MULTI-THREADED)	CINEBENCH R20 - CPU (SINGLE-CORE)	GEEKBENCH 4 - GPU COMPUTE (SCORE)	TOTAL WAR: WARHAMMER II - 1080P ULTRA (AVE./MIN. FPS)	BLACKMAGIC/ CRYSTALDISKMARK READ/WRITE (MB/S)	PCMARK 8 - HOME BATTERY ACC. (HH:MM)
MACBOOK PRO 16 (LATE 2019)	30,102	3,286	476	97,282	32.8/28	2,875/2,630	10:53
MACBOOK PRO 15 (2019)	24,351	2,356	462	48,805	12.9/10	2,517.3/1,223.2	10:17




LABS BENCHMARK RESULTS
PCMARK 8 - HOME (SCORE)
ASUS ZENBOOK 14 UX434FL 3,432
MICROSOFT SURFACE LAPTOP 3 13" 3,299
0 1,000 2,000 3,000 4,000 5,000
CINEBENCH R15 - CPU (MULTI-THREADED)
ASUS ZENBOOK 14 UX434FL 549
MICROSOFT SURFACE LAPTOP 3 13" 678
0 200 400 600 800 1,000
PCMARK 10 - EXPRESS (SCORE)
ASUS ZENBOOK 14 UX434FL 4,645
MICROSOFT SURFACE LAPTOP 3 13" 4,492
0 1,000 2,000 3,000 4,000 5,000
3DMARK TIME SPY (SCORE)
ASUS ZENBOOK 14 UX434FL 1,004
MICROSOFT SURFACE LAPTOP 3 13" 861
0 200 400 600 800 1,000
PCMARK 8 - BATTERY (H:MIN)
ASUS ZENBOOK 14 UX434FL 04:10
MICROSOFT SURFACE LAPTOP 3 13" 04:37
0 1 2 3 4 5

$1,949 | ASUS.COM/AU

Asus Zenbook 14 UX434FL

This 13-inch form factor ultrabook has a 14-inch display and a second touchscreen trackpad, but is this dual-display more trouble than it's worth?

Maybe it's the emergence of dual-screen smartphones or a realisation that lots of people use dual-screen workstations, but either way Asus' laptop division seems fixated on inserting a second screen wherever it can on its latest devices.

We tested out a Zenbook Duo recently and were pleasantly surprised by the usefulness of the oversized touchbar/second touchscreen, so we were actually looking forward to testing out the ZenBook 14 UX434FL with the trackpad-touchscreen combo interface. After a bit of use we learned that excitement was the incorrect emotion to have for this configuration – the correct one would've been dread.

On the Duo the second screen is the same width and the same horizontal resolution as the main display and it directly abuts the bottom edge of the primary screen, which makes for a convenient transition from one screen to the other. On the Zenbook 14 however, the second screen is trackpad sized and exists in the trackpad's usual location in front of the keyboard, which means that apps are sometimes annoyingly resized or weirdly arranged and moving things between the screens feels disconnected and inconvenient. Or, at least it would be if you could see it. The thing is, that second screen is almost entirely obscured by your hand whenever you're using the trackpad... so basically always.

Even though the screen isn't ideal as a computer display, it is smartphone sized, so it could theoretically house apps that display information or add convenience. Asus definitely tried to consider this, but unfortunately, it didn't stick the landing. The touchpad apps include mostly useless Office tools, unwanted security software, and a suite of MyAsus bloatware. Apart from the pushy McAfee security software (which entirely roadblocked use of the trackpad whenever it wanted) most of these apps are benign enough to ignore, except that in order to access them you have to disable trackpad usage, and for some reason Asus configured the software so this happens regularly, whether you want it to or not. Oh and the trackpad also crashes whenever the laptop is under a heavy load.

The complete failure of this trackpad is somewhat disappointing since the rest of the physical design is nice. The clamshell is wrapped in a full metal casing that buckles at the folded edge to prop the back of the keyboard up on a 4-degree incline. It's also got a bright FullHD 14-inch display with 6.45mm bezels and an 86% screen to body ratio. The ZenBook 14 UX434FL we tested had a powerful quad-core Intel Core i7-8565U CPU with 16GB of RAM and a super fast Gen 2 1TB PCIe SSD.

The Core i7-8565U is a powerful ultrabook processor that'll churn through work tasks and the device also has a discrete Nvidia GeForce MX150 2GB GPU so it's okay at very light gaming with a 10-20% performance bump on 10th gen integrated Intel and AMD graphics processors. With a pretty average four hour and 10 minute PCMark 8 battery life, this ZenBook 14 really isn't a bad ultrabook... apart from the trackpad.

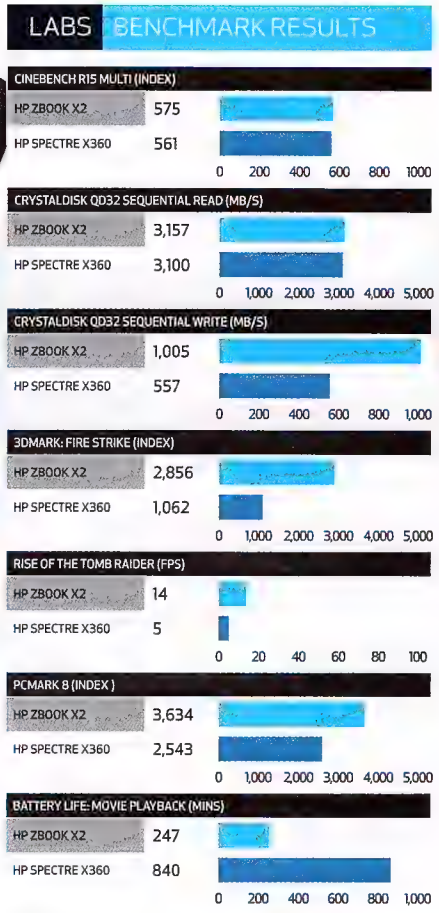
Joel Burgess

Verdict

Take the trackpad touchscreen out of the equation and it's an excellent laptop.

LAPTOP

$3,200 | WWW.HP.COM


LABS BENCHMARK RESULTS
CINEBENCH R15 MULTI (INDEX)
HP ZBOOK X2 575
HP SPECTRE X360 561
0 200 400 600 800 1000
CRYSTALDISK QD32 SEQUENTIAL READ (MB/S)
HP ZBOOK X2 3,157
HP SPECTRE X360 3,100
0 1,000 2,000 3,000 4,000 5,000
CRYSTALDISK QD32 SEQUENTIAL WRITE (MB/S)
HP ZBOOK X2 1,005
HP SPECTRE X360 557
0 200 400 600 800 1,000
3DMARK: FIRE STRIKE (INDEX)
HP ZBOOK X2 2,856
HP SPECTRE X360 1,062
0 1,000 2,000 3,000 4,000 5,000
RISE OF THE TOMB RAIDER (FPS)
HP ZBOOK X2 14
HP SPECTRE X360 5
0 20 40 60 80 100
PCMARK 8 (INDEX)
HP ZBOOK X2 3,634
HP SPECTRE X360 2,543
0 1,000 2,000 3,000 4,000 5,000
BATTERY LIFE: MOVIE PLAYBACK (MINS)
HP ZBOOK X2 247
HP SPECTRE X360 840
0 200 400 600 800 1,000

HP ZBook X2

A quirky but powerful tablet workstation

We know what you're thinking. Will you just look at those bezels? And that price. What the heck is HP doing with the ZBook X2, a $3,200 tablet that looks a decade old? But bear with us, because while this is a flawed device, it's also pretty special.

HP says the ZBook X2 is the world's most powerful detachable PC. A punchy claim at first glance, the detachable PC segment is in reality distinctly niche. In other words, the competition is fairly limited. Devices like the latest Microsoft Surface Pro 6 spring to mind, but despite being available with precisely the same Intel Core i7-8650U quad-core CPU as the ZBook, it isn't actually that comparable.

That's because of the ZBook's overall feature set and functionality, which is remarkable, if not quite always for the good. For starters, the ZBook offers not just discrete graphics but discrete workstation-class graphics, in the form of Nvidia's Quadro M620 GPU. More impressive is the ZBook's 14-inch DreamColor display. It's not only 4K, but very high fidelity, with 10-bit color, and support for fully 100 percent of the Adobe RGB color space. It's also paired with a Wacom EMR input pen, offering 4,096 pressure-sensitive levels, and claimed ultra-low latency. Other major items as configured include 16GB of RAM, and a 512GB Toshiba NVMe SSD.

Arguably, however, it's the industrial design that really stands out. This thing feels as though it could survive an all-out nuclear holocaust. It's all-alloy, totally rock solid, and beautifully put together. Even the hinged kickstand feels impeccably engineered.

If the build quality oozes professional intent, what to make of those bezels? Well, the point of them is to accommodate shortcut buttons either side of the display. HP's intent is to expedite navigating the dense menus and options in Adobe Creative Cloud applications, which can be awkward using an input pen. The result is a set of 12 buttons, six on each side of the display, which offer 18 preconfigured shortcuts customised for Adobe applications. Known as HP Quick Keys, the functions include quickly switching brush stroke size and hardness, turning touch on and off, pan and zoom, lock and unlock, and seeing a full-screen preview.

The ZBook has two USB Type-C ports with Thunderbolt support, enabling two external 4K monitors, one USB 3.1 Type-A, HDMI 1.4, an SD card reader, and a headphone jack.

As for raw performance, there are no real surprises. The Intel quad-core U series processor is a known quantity, and the ZBook's relatively chunky chassis means it performs to expectations. Likewise the Nvidia GPU and Toshiba SSD. In this age of relatively thin and light eight-core laptops, it's not going to set new standards for portable power, but it does offer real computing performance in a tablet form factor. What it doesn't offer is great battery life. Four hours is very poor indeed. Better battery life is possible using the integrated graphics, but that requires a trip into the BIOS, and comes at the cost of some functionality.

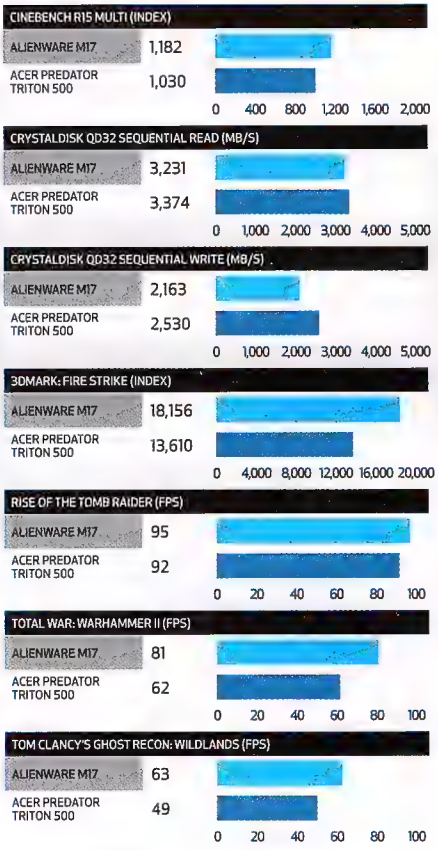
Ultimately, the ZBook is a niche product. For mainstream users, it offers poor value, but for content creators who do real work on the move, it's an intriguing and very high quality device. It's also been on sale for a little while now, so deals that undercut the fairly punitive official pricing should be available. ■ **Jeremy Laird**

Verdict

Stellar build quality; great features for pros.

apc RECOMMENDS

LABS BENCHMARK RESULTS


CINEBENCH R15 MULTI (INDEX)
ALIENWARE M17 1,182
ACER PREDATOR TRITON 500 1,030
0 400 800 1,200 1,600 2,000
CRYSTALDISK QD32 SEQUENTIAL READ (MB/S)
ALIENWARE M17 3,231
ACER PREDATOR TRITON 500 3,374
0 1,000 2,000 3,000 4,000 5,000
CRYSTALDISK QD32 SEQUENTIAL WRITE (MB/S)
ALIENWARE M17 2,163
ACER PREDATOR TRITON 500 2,530
0 1,000 2,000 3,000 4,000 5,000
3DMARK: FIRE STRIKE (INDEX)
ALIENWARE M17 18,156
ACER PREDATOR TRITON 500 13,610
0 4,000 8,000 12,000 16,000 20,000
RISE OF THE TOMB RAIDER (FPS)
ALIENWARE M17 95
ACER PREDATOR TRITON 500 92
0 20 40 60 80 100
TOTAL WAR: WARHAMMER II (FPS)
ALIENWARE M17 81
ACER PREDATOR TRITON 500 62
0 20 40 60 80 100
TOM CLANCY'S GHOST RECON: WILDLANDS (FPS)
ALIENWARE M17 63
ACER PREDATOR TRITON 500 49
0 20 40 60 80 100

LAPTOP

$5,489 | HTTP://DELL.COM

Alienware M17

No "out of this world" jokes, please.

As gaming laptops go, we have to admit that we like the design of this M17. The screen bezel is thin and black, and beneath it the speakers and fans sit below a hexagonal honeycomb mesh. It's surprisingly lightweight, too, and has quite a small profile when closed, as the screen hinge is mounted an inch or so into the base of the chassis from the rear edge, as opposed to on that edge.

The external hardware is hard to fault; the full-size keyboard is comfortable and responsive, with addressable RGB lighting for each key. The trackpad is perfectly fine, although plugging in a mouse makes more sense.

It's all about what's hidden inside that chassis, though. Four copper heat pipes and cooling fin stacks serve a 9th-generation Intel i7 CPU and a GeForce RTX 2080 graphics card – the slimmer, slightly less powerful Max-Q version, to retain the M17's slender profile. Two fans with liquid-crystal polymer blades channel air in through the top and bottom of the unit, then expel it through the rear and side vents.

Heat management isn't something this system does very well, though. The fans are quiet, to be fair, but the whole unit gets pretty hot after extended use, even for straightforward gaming. The six-core CPU frequently runs at around 50 C when the system is just idling, and leaps into the high nineties during complex rendering tasks. This is all the more confusing when you consider that the M17 apparently utilizes a handful of sensors for dynamic temperature control. It's a bit concerning, although the temperature spikes didn't lead to any noticeable performance issues in our testing, and this system isn't designed for workstation tasks.

Joining that RTX 2080 is 16GB of DDR4-2666 memory and two 512GB M.2 drives set up in RAID 0. As you might expect, the gaming performance is excellent (although those drives aren't particularly fast). The M17's display is a straightforward 1080p FHD panel; the maximum brightness is good, and the refresh rate goes up to 144Hz. It's a shame that this otherwise powerful system is limited to 1080p gaming, but it does provide a certain guarantee of performance by limiting gameplay to that resolution, and the screen is one of the better 1080p displays we've seen on a gaming laptop.

There are virtually no games that this laptop can't run at 1080p ultra. Yes, some particularly GPU-battering titles might not be able to quite hit 60fps at those settings, but for the most part, this is an extremely competent gaming laptop. It packs an HDMI port and Thunderbolt 3 support for daisy-chaining higher resolution monitors, if you want to push its capabilities a bit further, although the hardware isn't quite good enough to reliably play games at 4K ultra settings.

This version of the M17 is a solid product. Those familiar with Alienware's wares will know that you do pay a certain premium for its hardware, though, and the M17 is no exception – this model costs $2,700, a steep but not unreasonable price for what you get. Similar-spec laptops from the likes of MSI, Asus ROG, and HP Omen are a little more affordable, but there's a certain amount of style and promise provided by the Alienware brand. If Alienware has treated you well in the past, this laptop will only preserve your opinion. ■ **Christian Guyton**

Verdict

Great gaming performance; good connectivity; appealing design.

★★★★☆

apc HOT PRODUCT

DISPLAY

$5,180 | WWW.HP.COM

HP DreamColor Z31x Studio Display

It ain't fashionable, but it is awesome.

Too many tech companies are slaves to fashion. HP certainly isn't guilty of that crime with its DreamColor Z31x Studio Display, a glorious 31-inch panel, with what HP describes as full "cinema style" 4K resolution. To say that the Z31x defenestrates the vogue for slim screen bezels would be the understatement of the eon. This thing is *big*.

It is also, however, designed for serious professional productivity and content-creation work. So, quality, accuracy, and functionality are what matter, rather than superficial aesthetics. The Z31x has all of that in spades. For starters, those bezels are a function of its ability to fully calibrate itself. Top and center, HP has located a sensor that swings down on a motorised arm, allowing for full calibration.

What's more, the calibration tool can be set to run automatically. Similarly, the display can be configured to turn itself on and warm up on schedule. A nice trick, and indicative of the attention to detail HP has lavished on this screen. The same goes for other features, including a built-in KVM switch, dual DisplayPort inputs, two HDMI 2.0 sockets, a USB Type-C port with DisplayPort pass-through and charging power up to 60W, and an Ethernet port with support for configuring settings over a network via HTTP.

But it's the 31-inch IPS panel that really qualifies this screen as seriously special and worthy of true "pro" status. It all starts with that 4K "cinema" resolution. Specifically, that's 4096x2160 pixels, rather than the more typical 3840x2160 grid. It's thus slightly wider than the norm, with a 17:9 aspect ratio, and capable of showing 4K movie masters in full, which are encoded with 4,096 horizontal pixels.

Adding to its movie creation credibility, the Z31x can run at both 50Hz and 48Hz. The latter not only aligns with High Frame-Rate cinema content, it's also double the 24fps used by conventional theatrical releases, allowing for proper playback of major movie formats. The Z31x also has a true 2:1 pixel doubling mode, allowing 2K content to be displayed pixel for pixel, instead of via interpolation.

Next up is true 10-bit-per-channel color fidelity and support for multiple color spaces. HP says the DreamColor Z31x is good for 100 percent of the sRGB space, 100 percent of BT.709, 100 percent of AdobeRGB, 99 percent of DCI-P3, and 80 percent of BT.2020, also known as Rec2020.

If all that sounds impressive, it is, but there's an obvious omission: This is not HDR-certified. But it is still gorgeous with regards to image quality. With the full 4096x2160 resolution on a 31-inch panel, pixel density is fairly high, but it's the colors and accuracy you'll appreciate.

This screen looks bang on in native color mode and it's a cinch to jump into one of the numerous alternative calibrated color spaces via the OSD. There's loads of contrast on offer, too, and the viewing angles are as good as you're going to get from an LCD-based display. It's not eye-poppingly bright, but it's not supposed to be. What it's supposed to be is a seriously capable display for SDR content creation. It very much delivers on that remit.

Jeremy Laird

Verdict

Stunning panel quality; huge feature set for pros.

★★★★½

ROUTER

$649 | WWW.TP-LINK.COM/AU/

TP-Link Archer AX11000

The turbo-charged version of our favourite high-speed router. But with a price tag to match.

Back in March, TP-Link impressed the pants off us with its first Wi-Fi 6 router, the Archer AX6000. It's been our favourite wireless router ever since thanks to its high reliability, ease of manageability, speed and range. Now here's its suped-up, gaming-oriented big brother which almost literally dials everything up to 11; but is it killer or overkill?

The extra 5000 in the Archer AX11000's moniker derives from its extra 5GHz band: there are now two 4,804Mbps 5GHz bands plus a 1,148 2.4GHz band. This combines to provide a theoretical 10Gbps throughput but, this being Wi-Fi, how does it fare in the real world?

We tested in a three-storey Sydney townhouse using our new testing methodology which sends large video files from a Synology DS1019+ NAS to a Wi-Fi-6-equipped Dell XPS 15 OLED laptop at close range, one floor up and two floors up – all while simultaneously streaming 4K video to a TV plus Youtube to two, old, Android tablets. We tested both 5GHz bands and compared the speed to the Archer AX6000.

From the ground up the AX6000 scored: 481, 274 and 192Mbps. The AX11000's 5GHz Gaming band scored, 575, 319, and 205Mbps while the standard 5G band scored 638, 287 and 180Mb/s. So, up close it's 20-33 per cent faster, one floor up it's five-to-16 per cent faster while two floors up it's between four per cent faster and 10 per cent slower. Perhaps most notably for the two-floors-up test, our PC, which connects to the NAS over powerlines, scored 199Mbps so at least one of the wireless tests was faster on the AX11000. All of these are blistering speeds for any domestic routers: the AX11000 is streets ahead of the pack in first place but the AX6000 hot on its heels in second place.

Speeds are helped along with a 1.8GHz quad-core CPU plus three additional coprocessors. TP-Link also boasts about its Game Accelerator technology to keep latencies at a minimum. While we didn't notice any speed improvements (more significant bottlenecks lie on the WAN), the peace-of-mind factor provided by the top-of-the-line components may be important to competitive gamers – especially if they have bandwidth-hungry housemates. Meanwhile there are two USB 3.0 ports (Type-A and Type-C), a useful eight Gigabit Ethernet ports plus a WAN port which supports business-grade 2.5Gbps connections.

The device itself is an imposing beast and all antennae are fixed pointing upwards. Set-up is simple thanks to TP-Link's Tether app which gets you up and running quickly while easily providing access to the most important features over the LAN and across the internet. Advanced configurations need to be performed in a web browser. As with other AX routers, network security from Trend Micro is built in and there are some decent parental controls. It supports Alexa voice control plus IFTTT-compatible smart home devices too.

At $649 it's incredibly expensive and only extreme users will notice any difference over the AX6000. But it's noticeably faster and if you absolutely must have the best, then this is it.

Nick Ross

Verdict

Extreme performance and equally high-end pricing – but you get what you pay for.

★★★★★

$600 | WWW.DRAYTEK.COM.AU

DrayTek Vigor2620Ln

A unique router that aims to give multiple redundant options for internet connectivity.

In a world where it is increasingly important for businesses (as well as many home users) to be online at all times, and in all locations, the Vigor2620Ln gives much appreciated connectivity options. It can connected directly to an external internet source (such as an NBN modem) via WAN, but also has a VDSL2 and ADSL2+ modem built in. In other words, it will connect to existing wired broadband options without a hassle.

But the Vigor2620Ln really stands out from the crowd with the addition of a 3G/4G modem, allowing the use of mobile broadband. It's rated for up to 150Mbps, and handles the major frequencies (2100MHz, 1800MHz, 2600MHz, 900MHz, 800MHz) except 700MHz. The router supports two SIM cards for use with multiple providers. In theory you could have it set up with four different internet providers for massive redundancy. And of course, the 2620Ln supports failover, as well as loads of in depth bandwidith sharing options.

The 4G modem uses antennas on the modem, but they are removable so external ones can be used as well. This is great news for travellers (be it for work, or personal such as in a boat or caravan) as you can massively increase the range by buying larger antennas. Dual SIM cards is also very important, as it allows you to have two different providers (such as Telstra and Optus) who often each have better or worse coverage in certain areas.

The rest of the 2620Ln is fairly typical, and is of the same excellent quality we have come to expect from DrayTek. The router comes with basic 802.11n spec Wi-Fi built in (the 2620L model omits it for a saving of around $35) but you are better off using an external access point. The wireless connection is strong and fast up close, but the range is limited.

Round the back the 2620Ln sports dual Gigabit LAN ports, one of which does double duty as the WAN connection. There are no USB ports, but with 4G built in and most printers having their own Wi-Fi connection, this isn't much of a loss. There's also a WPS button, which can also be used to turn the Wi-Fi on and off.

The DrayTek interface and software is excellent, and the wizard will have you up and running quick smart. The router supports two SSL VPNs, for secure remote connections. It also has a built in firewall, and options such as content filtering, and bandwidth management failover modes. The router can also be used to manage two Vigor Wireless Access points, making it the heart of a larger business network. If you get stuck along the way, DrayTek has a huge library of articles in its knowledge base that can walk you through most configurations.

The 2620L series does a great job of providing excellent 4G connectivity and small business or pro user network management, on a modest budget. If you need better Wi-Fi or more features, DrayTek also has some more advanced but more expensive 4G-equipped routers. ■

Lindsay Handmer

Verdict

4G redundancy options and many features make up for slightly slow Wi-Fi and only two VPN tunnels.

GRAPHICS CARD

MSI RADEON RX 5500 XT GAMING X 8G $399 | WWW.MSI.COM
GIGABYTE GTX 1650 SUPER WINDFORCE OC 4G $319 | WWW.GIGABYTE.COM

MSI Radeon RX 5500 XT Gaming X 8G *vs.* Gigabyte GTX 1650 Super Windforce OC 4G

The next great battle in the budget GPU wars is here.

The world of budget gaming GPUs mightn't be headline-grabbing like it is at the high end, but that doesn't mean that this isn't a battleground. On the contrary. These are the cards that AMD and Nvidia sell in huge numbers to PC gamers around the world. If you're a gamer who laughs at the idea of spending $1,500 on a GPU or someone who loves a bit of *Fortnite* or *PUBG*, then these are the cards for you. Nvidia's GTX 1650 has been refreshed with a Super version, and it's now joined by AMD's RX 5500 XT. Which is the best card in this cut throat price segment right now? Let's see. Fight!

THE RX 5500 XT: AMD'S LONG AWAITED BUDGET NAVI CARD

Let's start with the Radeon RX 5500 XT. It's the truly new one of the pair, and it's got a great list of technological features, including a 7nm manufacturing process, GDDR6 memory and PCI Express 4.0 support. It's based on AMD's Navi generation GPU, which is the first iteration of its RDNA architecture. It offers better power efficiency compared to the outgoing Polaris based cards as well as a smaller die size, hopefully leading to lower manufacturing costs for AMD and hence better pricing for consumers. At $399 for the top end MSI though, its pricing is a good step above the 4GB variants as well as several budget minded 8GB designs.

On the topic of memory, it's got 8GB of GDDR6 onboard, but only a 128-bit bus, which means adequate, but not mind blowing memory bandwidth. This compares to the outgoing Polaris RX 480/580/590 which had a 256-bit bus albeit with slower GDDR5.

MSI's RX 5500 XT 8GB is equipped with the Twin Frozr 7 cooler. It's a little bit thicker than a true dual slot design, something to keep in mind. This cooler has earned a reputation for excellent thermal performance without compromising on noise levels. It's a dual-fan design with a fan stop function, meaning under idle or low load conditions, the fans don't spin at all. There's a solid backplate and also a splash of RGB lighting on the side of the card. Overall the build quality is excellent and it looks great too.

MSI's card uses a custom PCB, with a six-phase PWM. It comes with a 140W TDP. That's a bit high compared to the GTX 1650 Super. It also comes with a quality video output set, with 3x DisplayPort 1.4 and HDMI 2.0b ports. Its boost clock, which we saw maintained pretty much throughout testing, is 1845MHz, which is actually the same as the reference clocked RX 5500 XT. Perhaps a bit more would have been nice? The card is fed by a single 8-pin power connector.

THE 1650 SUPER REALLY IS SUPERCHARGED

The competition for the RX 5500XT is the GTX 1650 Super. In this case we have Gigabyte's Windforce OC

"Both cards perform well at the 1080p resolution. 1440p is a bit beyond them, at least with demanding games at the higher settings."

model on hand. The GTX 1650 Super isn't a simple refresh though. It makes use of the TU116 silicon, the same GPU found in the GTX 1660. The 1650 Super packs in 1280 cores vs the 1650's 896. Combine that with 50% more memory bandwidth thanks to the use of GDDR6, and it's clear the 1650 Super is much faster than the 1650. Perhaps the only real drawback is the increase in TDP from 75W to 100W. That's not unexpected though with the better GPU, and still less than the 140W TDP of the 5500XT.

Gigabyte's 1650 Super Windforce OC flavor isn't mega premium design, but that's not a bad thing in this price range. There's simply no need to over engineer a card with a 100W TDP. In our testing the Windforce cooler did an admirable job, and at its highest temperatures it was barely audible. It also held clocks in the 1780MHz to 1830MHz range, well above its rated 1755MHz boost clock.

The card comes with a tasteful backplate and 3x display outputs consisting of single DisplayPort 1.4 and HDMI 2.0b ports along a DVI-D port, something to take note of if you're using an older monitor.

Now we come to the all-important question, which one is better? Both cards perform well at the 1080p resolution. 1440p is a bit beyond them, at least with demanding games at the higher settings. The 5500 XT 8GB just has its nose in front in performance, though the 1650 Super is close behind. Note that the RX 590 is still a decent performer, and the 1660 Super that we rate highly, is a step ahead.

At this end of the market, pricing cannot be ignored and sadly the MSI 5500 XT is simply priced too high. It's got a terrific cooler and build quality as well as having more VRAM and outputs but at this price you can get a GTX 1660 Super which is a much better performing card. Freesync support adds weight to the 5500 XT and it's important to note that there are cheaper 8GB and particularly 4GB varieties of 5500XT. The MSI is what we have though, and it's simply too expensive at $399 vs the almost-as-fast Gigabyte 1650 Super at $319. If the 5500XT has a shelf life of anywhere near Polaris cards, then that pricing will not stay high. If 5500XT 8GB cards come down into the $300-$350 range, then they become a whole lot more compelling.

The Gigabyte 1650 Super Windforce is close to the 5500XT on performance while using less power and being cheaper. It would be nice to have 6GB or more on board, but you're not likely to run into too many VRAM limitations before the GPU itself runs out of puff – particularly if you're smart about what settings to dial back a notch to maintain 60fps+. The Gigabyte Windforce also gets ticks for its upgrade friendly DVI-D port, which along with its six-pin power connector and low power consumption keeps it widely compatible upgrade for older systems.

The 5500XT should settle in price once stocks build up and older Polaris based cards go off market. At that time we might go for the 5500 XT, but for now, The Nvidia options are better. If you've got $300 to $400 to spend, the 1650 Super is better at the lower end of that price range, while the 1660 Super remains the $400 pick. ■ **Chris Szewczyk**

Verdict

MSI RADEON RX 5500 XT GAMING X 8G

The RX 5500XT is a nice card really, but the GTX 1660 Super and AMD's own RX 580/590 provide tough competition.

★★★½☆

GIGABYTE GTX 1650 SUPER WINDFORCE OC 4G

The GTX 1650 Super is almost as fast as the 5500 XT yet is cheaper and more efficient. It's highly recommended.

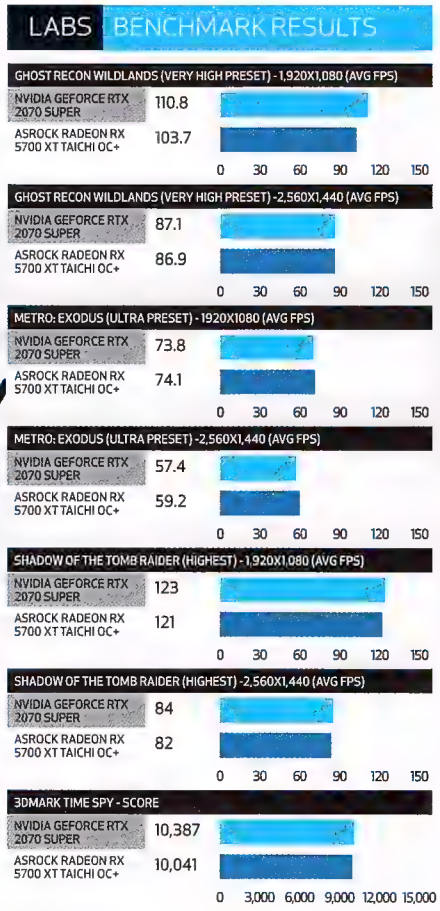
★★★★½

BENCHMARK RESULTS

	GHOST RECON WILDLANDS (VERY HIGH PRESET - AVG)		METRO: EXODUS (ULTRA PRESET - AVG)		SHADOW OF THE TOMB RAIDER (HIGHEST - AVG)	3DMARK (SCORE)
	1920X1080	2560X1440	1920X1080	2560X1440	1920X1080	TIME SPY
GIGABYTE GEFORCE GTX 1650 SUPER WINDFORCE OC 4G	66.0	47.3	35.3	27.0	61	5,086
MSI RADEON RX 5500 XT GAMING X 8G	64.3	47.9	38.1	30.5	65	5,310
NVIDIA GEFORCE GTX 1660 SUPER	77.9	57.8	42.7	33.2	76	6,423
AMD RADEON RX 590 8G	65.4	48.0	37.2	30.0	68	5,259

VIDEO CARD

$799 | WWW.ASROCK.COM


LABS BENCHMARK RESULTS
GHOST RECON WILDLANDS (VERY HIGH PRESET) - 1,920X1,080 (AVG FPS)
NVIDIA GEFORCE RTX 2070 SUPER 110.8
ASROCK RADEON RX 5700 XT TAICHI OC+ 103.7
0 30 60 90 120 150
GHOST RECON WILDLANDS (VERY HIGH PRESET) - 2,560X1,440 (AVG FPS)
NVIDIA GEFORCE RTX 2070 SUPER 87.1
ASROCK RADEON RX 5700 XT TAICHI OC+ 86.9
0 30 60 90 120 150
METRO: EXODUS (ULTRA PRESET) - 1920X1080 (AVG FPS)
NVIDIA GEFORCE RTX 2070 SUPER 73.8
ASROCK RADEON RX 5700 XT TAICHI OC+ 74.1
0 30 60 90 120 150
METRO: EXODUS (ULTRA PRESET) - 2,560X1,440 (AVG FPS)
NVIDIA GEFORCE RTX 2070 SUPER 57.4
ASROCK RADEON RX 5700 XT TAICHI OC+ 59.2
0 30 60 90 120 150
SHADOW OF THE TOMB RAIDER (HIGHEST) - 1,920X1,080 (AVG FPS)
NVIDIA GEFORCE RTX 2070 SUPER 123
ASROCK RADEON RX 5700 XT TAICHI OC+ 121
0 30 60 90 120 150
SHADOW OF THE TOMB RAIDER (HIGHEST) - 2,560X1,440 (AVG FPS)
NVIDIA GEFORCE RTX 2070 SUPER 84
ASROCK RADEON RX 5700 XT TAICHI OC+ 82
0 30 60 90 120 150
3DMARK TIME SPY - SCORE
NVIDIA GEFORCE RTX 2070 SUPER 10,387
ASROCK RADEON RX 5700 XT TAICHI OC+ 10,041
0 3,000 6,000 9,000 12,000 15,000

Asrock RX 5700 XT Taichi OC+

There's a new contender in town.

Back when we reviewed the reference AMD RX 5700 XT, we felt it was a competent GPU let down a little by its sub-par cooler and inflated price. The Asrock RX 5700 XT Taichi we're reviewing here doesn't do anything to address the latter, but it does wonders for the former. The Taichi's big, bold and beautiful cooler does a much better job at taming the hot Navi GPU. Does it translate into better performance too? And is the rather hefty asking price worth it?

The Asrock 5700 XT Taichi shares its branding and theme with the company's Taichi line of motherboards. It really looks great with its artistic cog design and its high end feature set. While Taichi motherboards might be more mid-tier products (though up a step from there in recent times), the 5700 XT is very much a flagship design, and is built and priced to compete with the likes of the Asus Strix and MSI Gaming cards.

The card is a triple fan 2.5 slot design, with a backplate and a fantastic looking RGB central fan. It demands to be shown off in a windowed case. If RGB isn't your thing, you can turn it off with a switch, avoiding the need to install yet another piece of software. It's a terrific idea. The PCB is a custom design, with a 10 Phase PWM and twin 8-pin power connectors capable of delivering a lot of power if required.

Interestingly, the Taichi comes with display stream compression enabled Display Ports, which mean the card can output resolutions as high as 8K at 60Hz. With four DP 1.4 and a pair of HDMI 2.0b connectors, The Taichi is as well-equipped as it gets at this point in time.

With its factory overclock, we'd expect the 5700 XT to outperform the reference model, and it did, but probably not by as much as we'd expect. Its real strength is its quieter noise levels. Where the reference 5700 XT is quite noisy when it is forced to speed up, the Taichi stayed (almost) silent throughout all of our testing, though it's not truly silent like we tend to see with some flagship models. Those extra couple of decibels are offset by cool running, with a peak recorded temperature of 71 degrees. It's at about 70 degrees that the full boost clock starts to drop away, so it was nice to see the Taichi holding its clocks above 2,000 MHz throughout almost all of our testing. This puts it very close to the Nvidia RTX 2070 Super Founders Edition, though at the cost of higher power consumption.

Asrock's RX 5700 XT Taichi is very much a premium card, but it has some tough competition from established premium GPU players. The Taichi needs to excel at acoustics/temperatures, value or performance to go head to head with the big boys. While it's a clear step up from the average reference 5700 XT, it probably doesn't quite do enough to be considered a class leader. There's nothing bad about it at all, and it looks fantastic, but we feel Asrock probably needs another generation to really hit its stride. Asrock is definitely a GPU brand to keep an eye on.

Chris Szewczyk

Verdict

Asrock's 5700XT Taichi is a particularly feature rich card, but its cooler is a tiny bit audible when gaming.

SMART SPEAKER

$329 | WWW.AMAZON.COM.AU

Amazon Echo Studio

Fantastic audio quality, very useful features and a great price make the Echo Studio a winner.

It's a very rare review that mentions a marketing stunt, but with Amazon's Echo Studio, it's warranted. The scene: the latest incarnation of Sydney's famous The Basement venue. The stage was literally a foot high with some instruments at the back and a table with a tablecloth covering something – not very impressive, frankly. The lights dim, a room full of seasoned, cynical tech journos prepare for the opening talk while music fills the auditorium. The keynote speaker comes to the table, removes the cloth to reveal that the room-filling music was coming from the Echo Studio all along. The room full of cynical tech journos, many of whom were at a very high-end Technics speaker launch the night before, almost all gasped at what the diminutive speaker had achieved.

The reasoning behind the Echo Studio's inception is valid: many people use their smart speakers to play music but most smart speakers struggle with high-end audio reproduction. As such, while the core functionality is old-school Echo smart-speaker, the audio components are very high-end and support 3D audio and Dolby Atmos. The cylindrical body contains three, two-inch mid-range speakers (two at the sides, one at the top), a one-inch, front-firing tweeter and an 5.25-inch sub. Peak audio output is a whopping 350 Watts. There's also a built-in Zigbee [smart device] hub meaning it can be the centrepiece of an entire smart home. If you've a Fire TV Stick, you can play your TV's audio through it.

Setting the speaker up is a simple affair although you'll naturally need an Amazon account to connect to first. You're instructed to download the Amazon Alexa app which then walks you through the connection to the point where Alexa starts talking to you directly and responding to your answers. The charcoal speaker itself is very smartly-designed with a colourful ring on top that reacts to what you're saying. Four small, discreet buttons allow for volume adjustment, microphone off and Alexa activation.

A free trial to Amazon's Music HD service provides instant access to a vast music library with "hundreds" of songs tailored to its 3D audio capabilities. It's also compatible with streaming services like iHeartRadio.

Another feature is Alexa Skills, which are 'Apps for Voice.' It allows you to ask Alexa for recipes and instructions on how to do tasks. Alexa will then either send the instructions straight to your phone or read through them. While it's still a little clunky, it generally made a good fist of answering most of our questions.

While we're still not totally convinced by the merits of having a listening device in our home, the quality of the audio and the usefulness of Skills have turned our heads. The kids also loved asking it to play music and tell jokes.

At $329 it's many hundreds of dollars cheaper than top-quality 'dumb' speakers from Bowers & Wilkins, Sonos and Technics. While high-end audio aficionados can achieve better quality by combining a regular Echo or Google Home with a top-quality speaker, there's much to like about this powerful, great-value, all-in-one package. ■

Nick Ross

Verdict

Fantastic sound quality for a fantastic price.

★★★★★

apc RECOMMENDS

"The Shield TV has one feature that most Android TV systems lack: Nvidia Games."

MEDIA AND GAMING STREAMER

US$150 | NVIDIA.COM

Nvidia Shield TV

The ultimate streaming player and gaming device in one.

The Nvidia Shield TV has always been something of an odd duck in the streaming-player crowd. The first-gen model had a clever idea – half game console, half streaming box – but a cumbersome design. The second-gen model corrected a lot of the lingering issues, but still cost an awful lot of money (up to $300) in a market where 4K HDR streamers usually go for $50.

With the new Nvidia Shield TV (US$150, with no official Australian price announced yet), the company is trying something a little different. Not only can you stream top-notch PC games from your own collection; you can also enjoy fast-loading 4K HDR content and ambitious AI upscaling for 1080p video. Then there's the Android TV OS, which offers thousands of apps, in addition to smart-home and digital-assistant compatibility.

The Shield TV has one feature that most Android TV systems lack: Nvidia Games. Selecting this will bring you to a variety of Android games, but also to GeForce Now. While GeForce Now has been through a few different iterations, it's now a free game-streaming service. There are a handful of games available absolutely free of charge, such as *Batman: Arkham City* and *Tomb Raider* (2013), but these are mostly holdovers from an earlier experiment.

For the most part, GeForce Now is a way to stream games that you've already purchased on Steam, UPlay and similar services. The way this works is actually quite clever. You sign into your Steam/UPlay account on a remote server, which then downloads the game and streams it right to your Shield TV. The Shield will let you know when you've picked an incompatible title.

Android TV has access to thousands of apps – although like most app stores, there's a lot more chaff than wheat. At the very least, you'll be able to get just about every major channel and just about every channel-specific streaming app out there.

It's worth noting that you can also program routines and even control certain smart-home gadgets through the built-in Google Assistant. If you prefer Alexa, you can also set up the Shield TV to work with commands from Amazon's digital assistant, including powering on, selecting content and pausing shows.

The Shield TV is a powerful device, sporting a Tegra X1+ processor, 2 GB RAM, 8 GB storage, and support for Dolby Vision and Atmos. As such, there's no reason to discuss video performance in great detail. The Shield TV loads and buffers 4K HDR content very quickly.

What's more interesting is what the Shield TV does with all its extra power. Nvidia has programmed in a proprietary form of AI upscaling. Without going into too much detail about how it works, the Shield TV employs an algorithm to make 1080p pictures look more like 4K images, both in motion and when paused. You can set this upscaling to Low, Medium or High, depending on how aggressive you want to get, or you can turn it off entirely if you don't trust it.

From its ambitious AI upscaling to its surprisingly solid game streaming, the Shield TV is definitely aiming for a gaming/streaming audience rather than the everyday binge-watcher. But I think it provides just about everything those gamers and streamers would need, at a much more approachable price than before. ■ **Marshall Honorof**

Verdict

Seamless game-streaming, fast-loading 4K HDR content and ambitious AI upscaling for 1080p video.

★★★★½

$199 | WWW.ATEN.COM

Aten US3342 2-Port USB-C Gen 2 Sharing Switch with Power Pass-through

You'll like this if you constantly connect USB devices between two computers.

You might be familiar with a KVM (keyboard, video, mouse) switch that lets you plug two computers into one monitor, keyboard and mouse, and you use a button to switch between the two computers. At first glance the Aten US3342 might appear to be a KVM, but it is not! The Aten US3342 is a "sharing switch" that uses the huge bandwidth of USB-C Gen 2 to allow a single keyboard and mouse to operate two separate computers simultaneously.

The main difference between the US3342 and a KVM is that there's no video output. The US3342 is purely for sharing USB inputs. An easy way to conceptualise the US3342 is that it's a USB switch. Press a button and the USB peripherals plugged in to the US3342 work on one computer. Press the button again and the USB peripherals work on the other computer. Press the button a third time and the USB devices are re-connected to the first computer.

If you're constantly swapping USB devices between two computers the US3342 will make life easier for you – just make sure to unmount/eject any hard disks or USB flash drives before switching, as pressing the switch is the same as physically unplugging the USB device and some storage devices don't like it when that happens.

As far as being a simple USB switch goes, the US3342 is well designed. Tough metal case, clear lights to indicate which computer is active and a separate physical switch with a long cord you can keep close to you for fast switching. The US3342 works on Mac and PC, so if you have a Windows laptop and a Mac laptop you want to switch between, the US3342 has you covered. The US3342 also supports up to 85W of USB-C PD charging on compatible devices, but you need to bring your own USB-C power supply as there isn't one in the box.

Aten includes a free piece of software called Bezel X with the US3342, which allows you to share the keyboard and mouse between the computers without having to press a physical switch. With Bezel X your two computers act as if they are one, with the mouse and keyboard input flowing between them as if they were external displays. The clipboard is retained between computers and superfast file transfer between the two computers is possible thanks to the 10Gbps USB-C connection – even between a Mac and a PC. It's very nifty but keyboard and mouse sharing software like Synergy works really well over a local network and is free, so this functionality alone probably isn't worth buying the US3342 for.

The US3342 isn't something every computer nerd needs, but if you're annoyed at frequently having to plug and unplug USB devices into two computers the Aten US3342 will relieve you of that burden for $199. ■

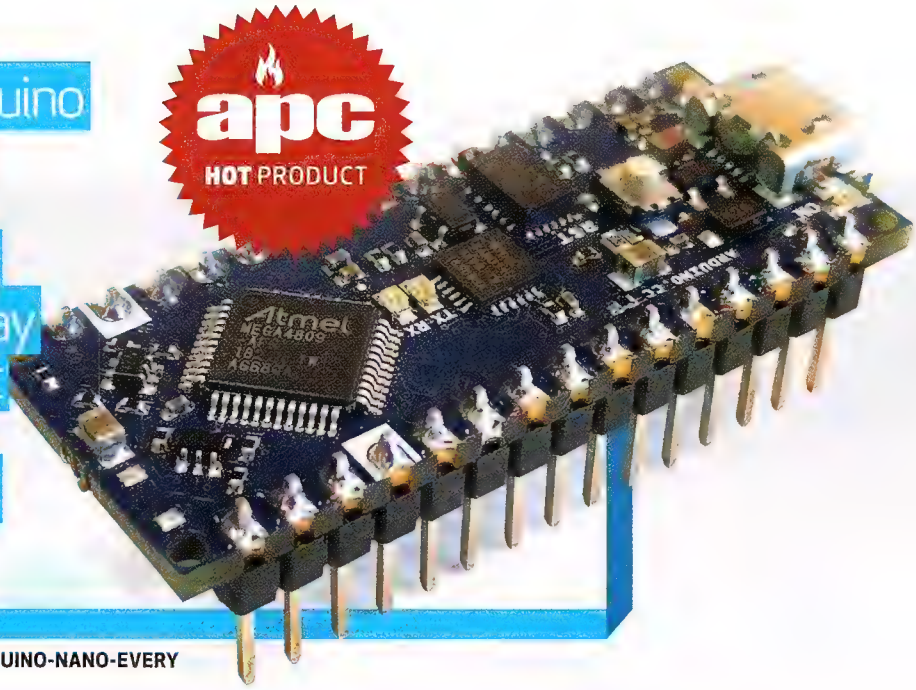
Anthony Agius

Verdict

Useful if you're often swapping USB devices between two computers.

★★★☆☆

"Powering the Arduino Nano Every is an ATMega4809 processor running at 20MHz. This may not sound like a lot of power, but for most projects this is plenty."



SINGLE BOARD COMPUTER

$22 | HTTPS://STORE.ARDUINO.CC/ARDUINO-NANO-EVERY

Arduino Nano Every

Could this new board offer more for less money?

Arduino offers the gold standard for microcontrollers, and with the latest batch of boards we see a refresh of the design and microcontroller. Let's start with the design. Rather than use the de-facto Arduino Uno layout, we see a 44mm by 18mm board, similar to the original Arduino Nano board, designed to be inserted into a breadboard. The Nano Every can be bought with or without soldered header pins, but both offer the same features. The unsoldered version, reviewed here, has spaces for the header pins to be soldered into, but there are also spaces to solder the board directly to another board via castellated mounting holes. Using these holes, we can solder a low-profile project, perhaps a surface-mount project, with ease.

Powering the Arduino Nano Every is an ATMega4809 processor running at 20MHz. This may not sound like a lot of power, but for most projects this is plenty. The ATmega4809 is not directly compatible with the older ATMega328P from Uno boards. But Arduino has cleverly created a compatibility layer that enables the Nano Every to work out of the box with all previous projects and libraries. The ATMega4809 processor retains 5V logic compatibility with older Arduino projects, but also provides a second serial interface. Why is that useful?

Typically older Arduino models had one serial interface, which could only be used by one device at a time, such as a GPS tracker. The output of the serial interface could not be seen by the user. With two serial interfaces, one can be reserved for use with a GPS tracker, and the output can be printed to the serial monitor for user debugging.

To power the board, typically the Micro USB port is used with a suitable 5V supply. But the board can also be powered via a new power supply architecture that offers up to 21V input voltage, regulated by an onboard DC to DC converter. This also provides up to 950mA of current for peripherals without overheating. So now we can power 15 neopixels at full brightness without stressing the board.

So who is the intended audience for this board, and what will they be making? This is an entry-level board for those new to Arduino, and it has been designed to be easy to use with software and hardware. It can be programmed using the standard Arduino IDE, Arduino's own cloud-based Arduino IDE and the recently released Arduino Pro IDE. The size of the board lends itself to embedded applications, wearables and robotics.

The Arduino Nano Every has a lot going for it: a very low price for an official Arduino board, which could tempt many away from using clone boards; compatibility with older boards and sketches; and a small form factor. If you are looking to buy your first Arduino then this is a viable choice. The only thing that lets this board down is the GPIO pins, which have no visible reference. Arduino boards often have their pin references written upon the top of the board, but the Nano Every has this reference on the underside of the board, which is not much use when used with a breadboard.

It may not be an all-powerful CPU monster, but do we really need that much power to make an LED flash or to control a robot? This is a simple and cheap board designed to help you dip your toe into embedded electronics, and it will suit the needs of most who just want to get a project working with small overheads. ■ **Les Pounder**

Verdict

Cheap and easy to use. This one is for new Arduino users, but if you're an Arduino expert, there's plenty to like.

"To ensure that your project is not part of a botnet, the onboard crypto chip is configured to connect securely and via encryption to the IoT Cloud."

SINGLE BOARD COMPUTER

$40 | HTTPS://STORE.ARDUINO.CC/ARDUINO-NANO-33-IOT

Arduino Nano 33 IOT

We don't need a powerful device to create an Internet of Things project – we just need the right kit.

In the past, getting an Arduino connected to the internet was a bit of a faff. We either used an ethernet shield or connected to an ESP device via a jumble of wires. But with the Nano 33 IOT we have full Wi-Fi and Bluetooth connectivity on a board measuring only 48mm by 18mm – the same size as the Arduino Nano Every. So with this board, can we finally make IoT (Internet of Things) projects? Yes!

This board is best paired with Arduino's new IoT Cloud, where it can be programmed as a 'thing' that can perform a task and report back to the cloud, or it could be a thing that receives control data from the cloud and reacts accordingly. So if you need to build an IoT device, this could be your solution.

The SAMD21G18A package provides an Arm Cortex M0+ processor, which provides plenty of power for your project and related internet connectivity. The onboard ESP32 is used for Wi-Fi and Bluetooth (Bluetooth power consumption is higher than in the Nano 33 BLE), which can be configured via the IoT Cloud. To ensure that your project is not part of a botnet or sending sensitive data in the open, the onboard crypto chip is configured to connect securely and via encryption to the IoT Cloud. The board is also pre-certified for RF compliance. Why is that important? In industrial, medical and military projects devices have to have RF compliance to ensure that they do not interfere with other devices.

The Nano 33 IOT shares the same castellated mounting holes as the Nano Every. Using these holes, we can solder a surface mount project with relative ease. This makes the Nano 33 IOT ideal for embedded IoT projects.

To power the Nano 33 IOT a Micro USB port can provide 5V, but the board will also support up to 21V via the VIN pin of the GPIO. But the logic level, the voltage at which GPIO pins run, is not the typical 5V – this is a 3.3V-only board, so while the form factor of the Nano 33 IOT matches other Nano boards, great care should be taken to ensure that the voltage does not exceed 3.3V.

But what else does this board have to offer? Well a built-in IMU (inertial measurement unit) accelerometer and gyroscope offers six axes of measurement. This means that the board can be used to measure forces and movement, and when this is used with the IoT aspect of the board we can build a simple device to measure the forces acting upon an object or person.

So what, if anything, is wrong with this board? Minor niggles include the labelling of GPIO pins and the lack of an external aerial connector. The GPIO pins, just like the Nano Every, are not labelled on the top side of the board, but are numbered instead on the underside, which is a pain to see and reference. The lack of an external aerial is bothersome because it reduces the range at which the Nano 33 IOT can be used. But both of these are only minor issues and do not detract from the board.

Overall this board is important quite simply because it has everything that we need for an IoT device in a small form factor. It provides a solid platform for projects while not breaking the bank. The form factor belies the true power of the board, and when teamed up with the Arduino IoT Cloud we have a simple workflow to get projects built and running. ■

Les Pounder

Verdict

A tiny yet mighty board for IoT projects. If you need reliability in a small form factor then Arduino again delivers.

★★★★☆

software

» APPS FOR ALL YOUR PLATFORMS

Windows SOFTWARE

Balabolka

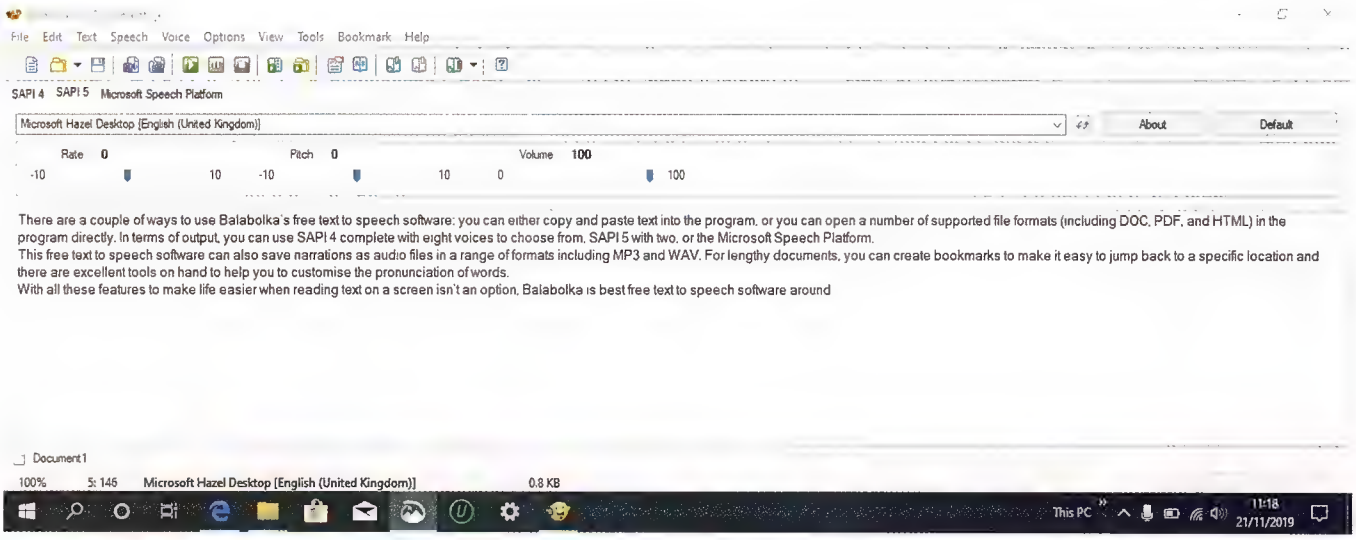
The best of the free apps.

FREE | WWW.CROSS-PLUS-A.COM/BALABOLKA.HTM

There are a couple of ways to use Balabolka's free text to speech software: you can either copy and paste text into the program, or you can open a number of supported file formats (including DOC, PDF, and HTML) in the program directly. In terms of output, you can use SAPI 4 complete with eight voices to choose from, SAPI 5 with two, or the Microsoft Speech Platform.

This free text to speech software can also save narrations as audio files in a range of formats including MP3 and WAV. For lengthy documents, you can create bookmarks to make it easy to jump back to a specific location and there are excellent tools on hand to help you to customise the pronunciation of words.

With all these features to make life easier when reading text on a screen isn't an option, Balabolka is the best free text to speech software around.


File Edit Text Speech Voice Options View Tools Bookmark Help
SAPI 4 SAPI 5 Microsoft Speech Platform
Microsoft Hazel Desktop (English (United Kingdom))
About
Default
Rate 0
Pitch 0
Volume 100
There are a couple of ways to use Balabolka's free text to speech software: you can either copy and paste text into the program, or you can open a number of supported file formats (including DOC, PDF, and HTML) in the program directly. In terms of output, you can use SAPI 4 complete with eight voices to choose from, SAPI 5 with two, or the Microsoft Speech Platform.
This free text to speech software can also save narrations as audio files in a range of formats including MP3 and WAV. For lengthy documents, you can create bookmarks to make it easy to jump back to a specific location and there are excellent tools on hand to help you to customise the pronunciation of words.
With all these features to make life easier when reading text on a screen isn't an option, Balabolka is best free text to speech software around
Document1
100% 5: 146 Microsoft Hazel Desktop (English (United Kingdom)) 0.8 KB
This PC
11:18
21/11/2019

Natural Reader

Easy to use, with many features.

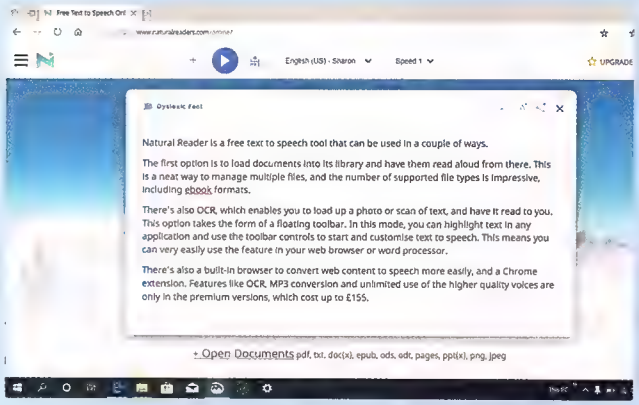
FREE | WW.NATURALREADERS.COM/ONLINE

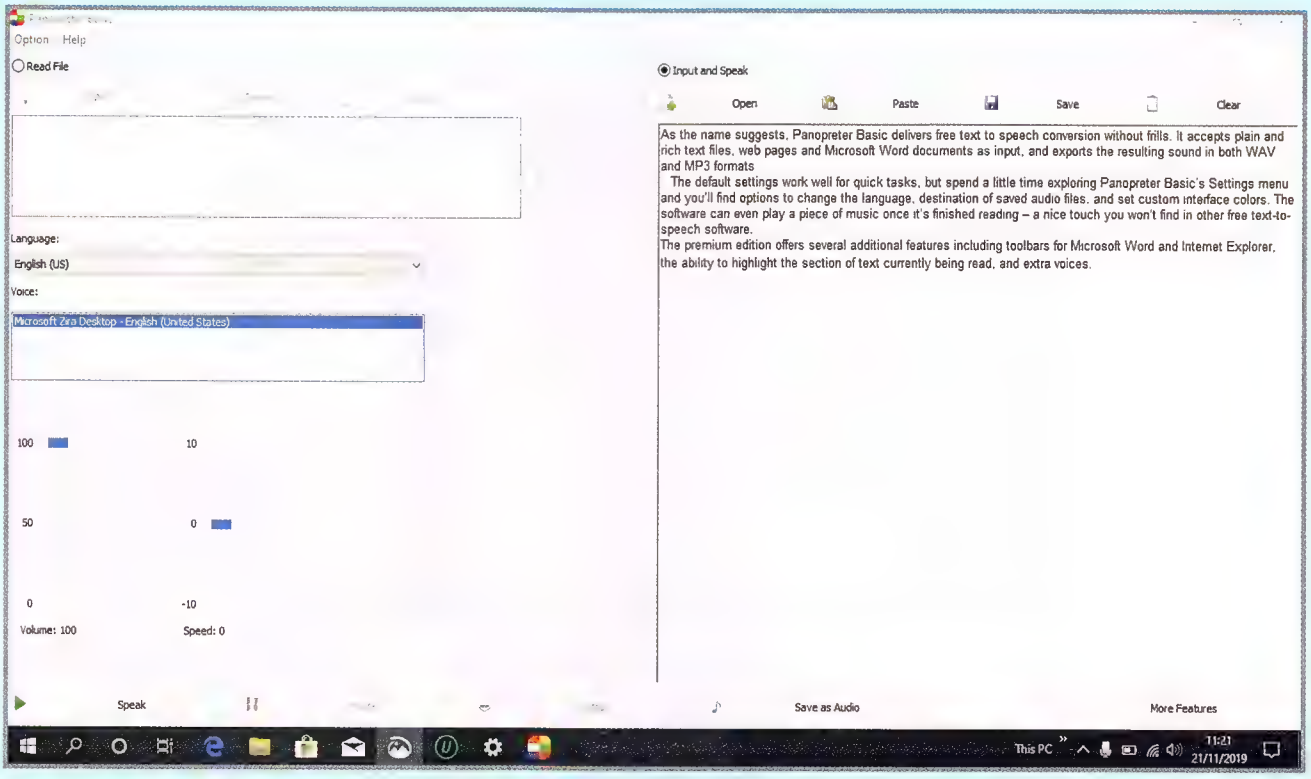
Natural Reader is a free text to speech tool that can be used in a couple of ways.

The first option is to load documents into its library and have them read aloud from there. This is a neat way to manage multiple files, and the number of supported file types is impressive, including ebook formats.

There's also OCR, which enables you to load up a photo or scan of text, and have it read to you. This option takes the form of a floating toolbar. In this mode, you can highlight text in any application and use the toolbar controls to start and customise text to speech. This means you can very easily use the feature in your web browser or word processor.

There's also a built-in browser to convert web content to speech more easily, and a Chrome extension. Features like OCR, MP3 conversion and unlimited use of the higher quality voices are only in the premium versions, which cost US$9.99/month.


Natural Reader is a free text to speech tool that can be used in a couple of ways.
The first option is to load documents into its library and have them read aloud from there. This is a neat way to manage multiple files, and the number of supported file types is impressive, including ebook formats.
There's also OCR, which enables you to load up a photo or scan of text, and have it read to you. This option takes the form of a floating toolbar. In this mode, you can highlight text in any application and use the toolbar controls to start and customise text to speech. This means you can very easily use the feature in your web browser or word processor.
There's also a built-in browser to convert web content to speech more easily, and a Chrome extension. Features like OCR, MP3 conversion and unlimited use of the higher quality voices are only in the premium versions, which cost up to £155.
+ Open Documents pdf, txt, doc(x), epub, ods, odt, pages, ppt(x), png, jpeg


Option Help
Read File
Input and Speak
Open
Paste
Save
Clear
As the name suggests, Panopreter Basic delivers free text to speech conversion without frills. It accepts plain and rich text files, web pages and Microsoft Word documents as input, and exports the resulting sound in both WAV and MP3 formats
The default settings work well for quick tasks, but spend a little time exploring Panopreter Basic's Settings menu and you'll find options to change the language, destination of saved audio files, and set custom interface colors. The software can even play a piece of music once it's finished reading – a nice touch you won't find in other free text-to-speech software.
The premium edition offers several additional features including toolbars for Microsoft Word and Internet Explorer, the ability to highlight the section of text currently being read, and extra voices.
Language:
English (US)
Voice:
Microsoft Zira Desktop - English (United States)
100
10
50
0
0
-10
Volume: 100
Speed: 0
Speak
Save as Audio
More Features
This PC
11:21
21/11/2019

Panopreter Basic

Basic, yet with many good options.

FREE | WWW.PANOPRETER.COM/EN/PRODUCTS/PB/INDEX.PHP

As the name suggests, Panopreter Basic delivers free text to speech conversion without frills. It accepts plain and rich text files, web pages and Microsoft Word documents as input, and exports the resulting sound in both WAV and MP3 formats.

The default settings work well for quick tasks, but spend a little time exploring Panopreter Basic's Settings menu and you'll find options to change the language, destination of saved audio files, and set custom interface colors. The software can even play a piece of music once it's finished reading – a nice touch you won't find in other free text-to-speech software.

The premium edition offers several additional features including toolbars for Microsoft Word and Internet Explorer, the ability to highlight the section of text currently being read, and extra voices.

WordTalk

For simple needs...

FREE · WWW.WORDTALK.ORG.UK/HOME

Developed by the University of Edinburgh, WordTalk is a toolbar add-on for Word that brings customisable text to speech to Microsoft Word. It works with all esitions of Word and is accessible via the toolbar or ribbon, depending on which version you're using. The toolbar itself is certainly not the most attractive you'll ever see, appearing to have been designed by a child. Nor are all of the buttons' functions very clear, but thankfully there's a help file on hand to help.

There's no getting away from the fact that WordTalk is fairly basic, but it does support SAPI 4 and SAPI 5 voices, and these can be tweaked to your liking. The ability to just read aloud individual words, sentences or paragraphs is a particularly nice touch. You also have the option of saving narrations for later.

Help
Developed by the University of Edinburgh, WordTalk is a toolbar add-on for Word that brings customizable text to speech to Microsoft Word. It works with all editions of Word and is accessible via the toolbar or ribbon depending on which version you're using. The toolbar itself is certainly not the most attractive you'll ever see appearing to have been designed by a child. Nor are all of the buttons' functions very clear, but thankfully there's a help file on hand to help
There's no getting away from the fact that WordTalk is fairly basic, but it does support SAPI 4 and SAPI 5 voices, and these can be tweaked to your liking. The ability to just read aloud individual words, sentences or paragraphs is a particularly nice touch. You also have the option of saving narrations for later
Inbox (13) - miles.mu...
Sophos Central - Goo...
Classic Cars for Sale | ...
64 (D:)
Active Directory Users...

Mac » APPS

Virtual machine graphics make best use of Retina displays, and use Apple's Metal API for improved performance.

Parallels Desktop 15

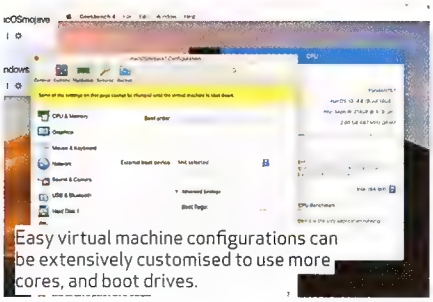
Run almost any operating system in a virtual machine.

FROM £5.83/PER MONTH | PARALLELS.COM | NEEDS MACOS 10.12.6 OR LATER

There are now even more good reasons for running a different operating system within a virtualisation environment like Parallels Desktop. You may need access to Windows apps, want to play games unavailable on macOS, or access old apps which can't run in Catalina.

Parallels 15 is now fully compatible with macOS 10.15 Catalina, both as host and running in a VM. Parallels is providing an update with final tweaks to ensure it works fully with Sidecar and Sign in with Apple in the release version of Catalina. You can use Sidecar with an Apple Pencil to interact with Windows 10 in its tablet mode.

It's hard to find an operating system which Parallels 15 doesn't support in a virtual machine. Not only that, but no matter what format you present its installer, it turns it into a VM with minimal effort on the part of the user. It can, for instance, migrate your existing Boot Camp partition into a new Windows VM.



Easy virtual machine configurations can be extensively customised to use more cores, and boot drives.

Windows VMs offer several options which you can customise to your needs. Coherence mode is ideal if you need to integrate just a few Windows apps with predominantly macOS software, for example. You can tune this, although switching into and out of what are fundamentally Windows apps still takes some getting used to.

Raw processor performance is inevitably as good as the Mac you're running it on, and the number of cores given to Parallels. Given an iMac Pro with a native Geekbench single core score of 5300, a Parallels VM comes close with 5100. Because your virtual machine is 'cleaner' than the host macOS, low-down functions such as writing Signpost entries in the log may be faster in Parallels, taking only 450 nanoseconds in a VM, against a more typical 510ns in the host macOS.

FUN-FILLED POWER

For games and other graphics-intensive apps, version 15 brings major improvements. Not only does virtualisation work much better with Metal-accelerated graphics in the host macOS, but in Mojave and Catalina hosts, Windows DirectX 11 (as well as 9 and 10) works directly with Metal. This lets you run CAD/CAM apps like Autodesk 3ds Max, and games such as *Age of Empires: Definitive Edition* (although they do need a good host graphics card), and takes full advantage of Retina displays. Version 15 can also run Xbox games in a Windows 10 VM, and supports Xbox and other Bluetooth LE controllers.

Pro and Business users can incorporate Windows VMs into a Trusted Platform Module (TPM) environment, using BitLocker and features such as virtual smart cards.

Parallels Desktop 15 delivers advances that make it better in almost every way than using Boot Camp, and well ahead of competitors, for the moment at least. ■ **Howard Oakley**

Memos: Private Search

Search your images for text.

$4.99 | MEMOS.ORG
NEEDS NEEDS IOS 12 OR LATER

As more and more data is stored on our iPhones and iPads, finding things can become problematic. Especially when it's so easy to take a photo of a receipt or a page from a book for quick reference. The content of images, at least when it comes to text information, is not searchable by iOS. But it is by Memos: Private Search.

After granting photo library access, the app scans your library, downloading images from the cloud if necessary but not storing them locally. It's best to be on Wi-Fi and connected to power the first time you do this. To analyse 2,100 images, many stored in iCloud, took around 25 minutes on an iPhone 8 Plus using fast Wi-Fi.

You only have to do this big scan once, and images added subsequently are scanned more quickly. It uses algorithms to identify text inside 'flat' image files and make it searchable. The results are remarkable – it's quick and accurate, and provides a green box around the text it finds. You can draw custom boxes and copy or share the results as text or image files, as well as adding tags. There are so many uses for this: extracting phone numbers or addresses from a screen-grabbed image to plain text, copying whole paragraphs from scanned documents, and so on. It's the kind of app that Apple could conceivably buy and integrate into iOS. **Hollin Jones**

Processing
Hang tight while your library is processed. This could take a while depending on its size.
If some of your photos only exist in your iCloud Photo Library and not on your device, Memos will need to download them for processing.
These images will not be saved to your device. We recommend being
Photo
50 Minutes Ago
10:23
57%

Auxy 6

The minimalist music maker.

FREE, OFFERS IN-APP PURCHASES | AUXY.CO
NEEDS IOS 10.3 OR LATER

Auxy is one of the simplest ways to compose on the go. But it's also powerful enough to create complex multitrack arrangements combining multiple effects and extensive automation.

Version 6 introduces more effects for instruments, and there's category-based sound browsing. You can import samples from other apps, and move notes and automation while editing.

Auxy works for those who want to do everything on their iPad or iPhone, and those who want to use it as a mobile musical notepad. You can produce complete tracks and export to SoundCloud. If you use it as a notepad, you can link to other apps via Ableton Link, or export a project as an Ableton Live set.

Auxy's best suited to electronic music – a vocal or live instruments need to be imported. Coloured boxes represent each loop and making a loop is a matter of tapping where you want a note or beat to play, dragging your finger for longer notes.

Auxy is free, but a subscription ($6.99/month or $65.99/year) unlocks all the features and includes access to the regularly released sound packs that expand the already impressive audio library. **Carrie Marshall**

Google Play » ANDROID

Sesame Street Yourself

Me perpetually want cookie.

$4.49 FOR ALL PACKS | WWW.SESAMESTREET.ORG

Sesame Street continues to endure and delight, and the Sesame Street Yourself app is a great way of keeping young kids distracted that won't cost you hundreds in sneaky microtransactions. Sesame Street Yourself lets you transform your face into one of several *Sesame Street* characters (including Elmo at no initial charge) and sing along to songs, dress them up, and play some very simple games. As you might expect, it's aimed very directly at small kids. Don't expect any of the real fun, more adult-orientated parody stuff here – you're not going to get a spot-on *Sesame Street* parody of *Mad Men* or *Twin Peaks*. Instead, you'll get a decent, well-made AR app with some fun songs, simple controls, and lots of great *Sesame Street* characters. It's all very simple, but it's bright and colourful, and even as a man in my thirties it was fun to open my mouth and see Elmo do the same thing on screen. Plus, it's not predatory – a very small payment unlocks everything, as it should be with kids apps. **James O'Connor**

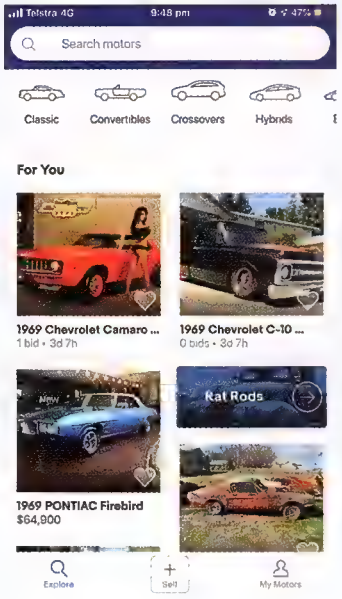
When you see stars it's your turn.

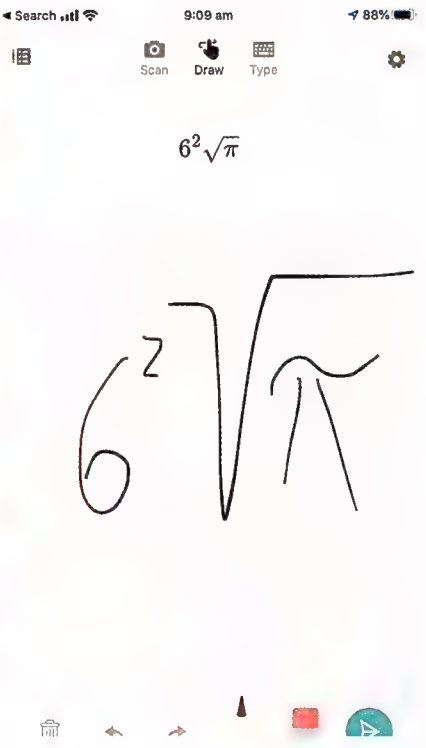
eBay Motors

Baby you can drive my car.

FREE | EBAY.COM

eBay Motors is a fun app right now, but not a very useful one. It's focused on buying and selling cars, and every time I've loaded it up the front page has been full of interesting vehicles – Batmobile replicas, F1 racers, classic Mustangs, a 1976 Lincoln that was apparently previously owned by Elvis Presley. All fun cars, none of which I can buy, because eBay Motors is inexplicably available on the Australian app store despite only letting you search for, buy, and list cars in America right now. If it ever expands, of course, it'll be much easier to recommend. It lets you search by car type and location, as you'd expect, and each entry clearly labels the price, model, and (in the case of auctions) time left to bid before you click through on them. For now, though, it's a curio, a repository of cars and a way to see what kind of wild stuff people are selling. It's fun! But functionally useless. If you're not actually in the market to sell or buy, perhaps add an extra point to the score. **James O'Connor**





Microsoft Math Solver

High School Part 2.

FREE | HTTPS://MATH.MICROSOFT.COM

I've got to give it up for Microsoft Math Solver, an app that gave me anxious flashbacks to high school and which I deleted off my phone pretty quickly, but which will, without question, prove useful almost every single day by some people. Microsoft Math Finder takes equations – either written out on a piece of paper, drawn out onto your phone screen with a finger, or typed into the in-app calculator – and spits out both the answer and the working that would have gone into it if you had done it yourself. I know enough about maths to know that this doesn't mean that no one will ever have to solve an equation again, but not enough to be able to say what the limits are, exactly. What I do know, though, is that the app can navigate complex equations, that the recognition software is very effective, and that it's sure to prevent human error when maths problems must be solved. **James O'Connor**

AntiX 19

Linux is often suggested to breathe new life into old computers, so Neil Bothwick spins up a distro that is said to be ideal for this.

FREE | HTTPS://ANTIXLINUX.COM

There are many reasons for choosing a particular distro: you may want something stable and predictable, you may want the latest software, or you may just like the look of it.

One factor often considered is whether it will work on older hardware. We are constantly told that Linux is good for revitalising older hardware, and AntiX sounds like it should be a good distro in these circumstances – but is it?

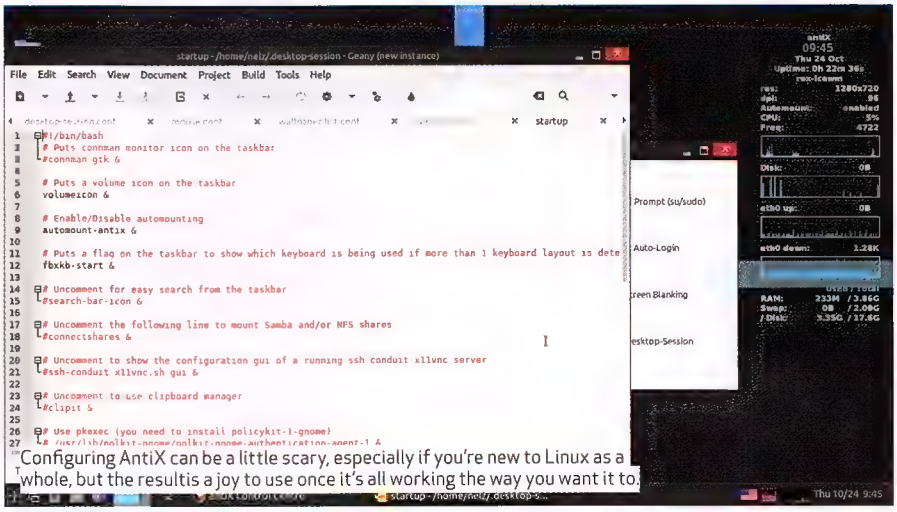
As befits a distro intended for older kit, AntiX is a member of that ever more exclusive club of distros that fully support 32-bit processors, with all ISOs available for both CPU variants. We tried the full size, though there are smaller ISO images: core, with just the basic programs, and the even smaller netinst for a network install. Those would be useful on really constrained systems as you can minimise the install to only what you need. The 64-bit DVD ISO is still only just over a gigabyte.

Installation was quick and easy; just answer the usual questions about where to install it and who will use it and off it goes. Once installed, AntiX boots – very quickly – into a desktop using the IceWM window manager, although you also have the option of using Fluxbox or Jwm. IceWM is the most conventional of these choices and so is a good choice for the default.

ICE ICE, BABY

IceWM is a lightweight window manager yet still has plenty of features. Accessing those features is not always as easy as with larger desktop environments, sometimes requiring editing configuration files by hand, but if you want lightweight, you have to sacrifice something. Having said that, the configuration files are usually well-commented, making it much easier to get to what you want.

Sometimes, though, it's less than intuitive; for example, setting a different screen resolution in the Control Centre only changes it for the current session.To make it permanent you need to save the setting, which creates a script file, then add that script file to the User Desktop-Session option in the Control Centre. Once you understand this way of working it soon becomes second nature, and it does offer a lot of flexibility. In most cases this only needs to be done once anyway.


File Edit Search View Document Project Build Tools Help
startup
#!/bin/bash
Puts conkman monitor icon on the taskbar
conkman gtk &
Puts a volume icon on the taskbar
volumeicon &
Enable/Disable automounting
automount-antix &
Puts a flag on the taskbar to show which keyboard is being used if more than 1 keyboard layout is dete
fbxkb-start &
Uncomment for easy search from the taskbar
#search-bar-icon &
Uncomment the following line to mount Samba and/or NFS shares
#connectshares &
Uncomment to show the configuration gui of a running ssh conduit x11vnc server
#ssh-conduit x11vnc.sh gui &
Uncomment to use clipboard manager
#clipit &
Use pkexec (you need to install policykit-1-gnome)
Prompt (su/sudo)
Auto-Login
esktop-Session
Thu 10/24 9:45

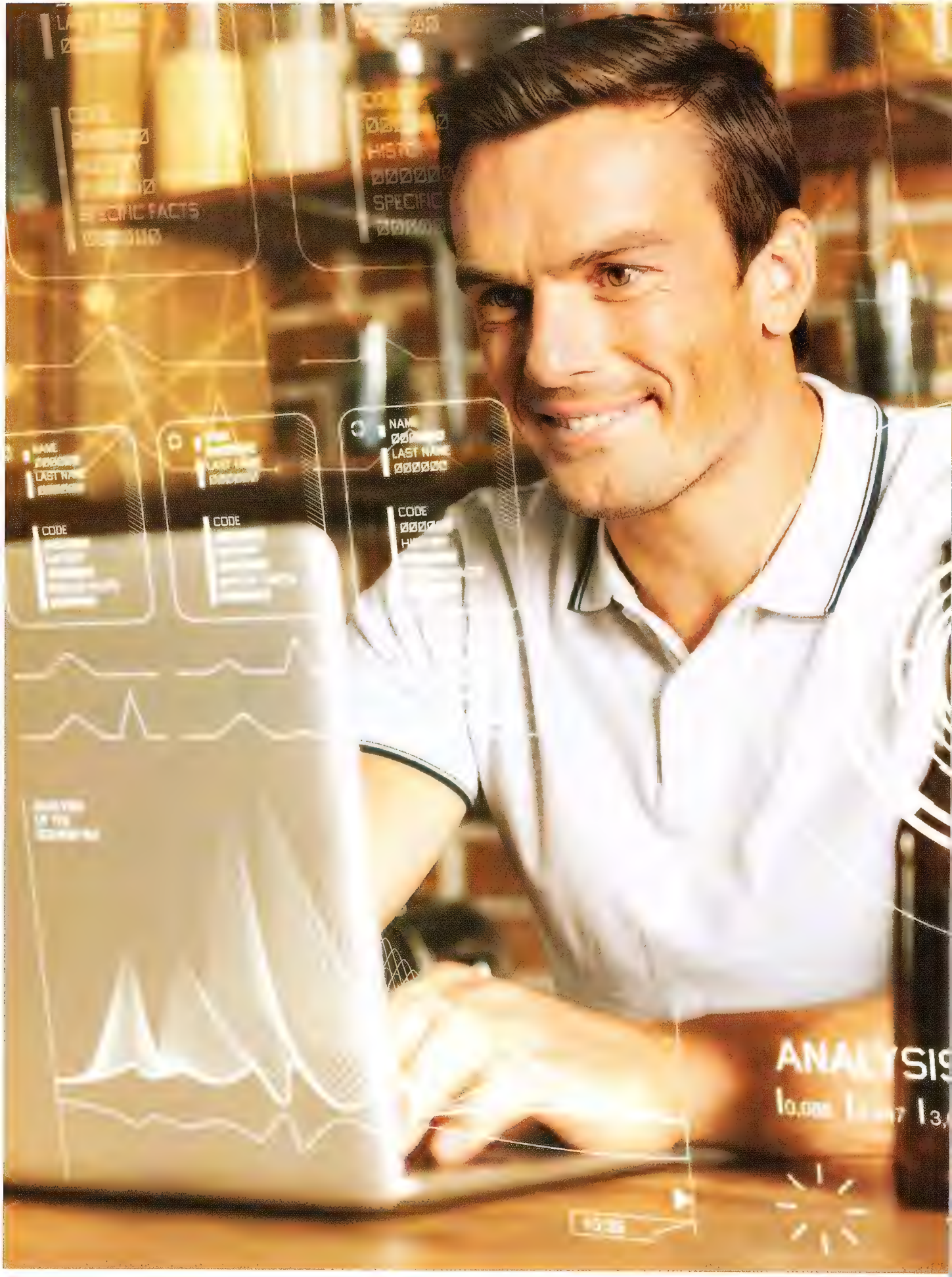
Configuring AntiX can be a little scary, especially if you're new to Linux as a whole, but the resultis a joy to use once it's all working the way you want it to.

> "It is so much snappier, especially on older hardware."

It will take longer to get AntiX and IceWM working exactly the way you want than with a full-fat desktop environment, but you will get that time back with interest as it is so much snappier, especially on older hardware. The AntiX Control Centre groups together all settings, making the task that much easier compared with a raw IceWM setup, which we had to go through a few years ago and which wasn't much fun.

Some of the choices of default software are a little surprising for a system aimed at older hardware. For example, the default mail program is the lightweight Claws Mail, but the browser is Firefox and the office suite is LibreOffice. There's nothing wrong with either of those, but there are certainly lighter alternatives. They may be less familiar, but AntiX is already taking its users into unfamiliar territory with IceWM, so why not go further?

If you want something that runs well on more restricted hardware, or you just prefer to use your computer power for computing rather than eye candy, AntiX is well worth considering. It requires some initial investment if you want anything other than the default setup , but you will be rewarded with a fast and effective Linux desktop experience. However, we wouldn't recommend this for a new Linux user unless they had someone to hold their hand at the start. ■


CODE
CODE
CODE

50 ESSENTIAL FREE APPS

Alex Cox shows how you can do whatever you want, and pay absolutely nothing.

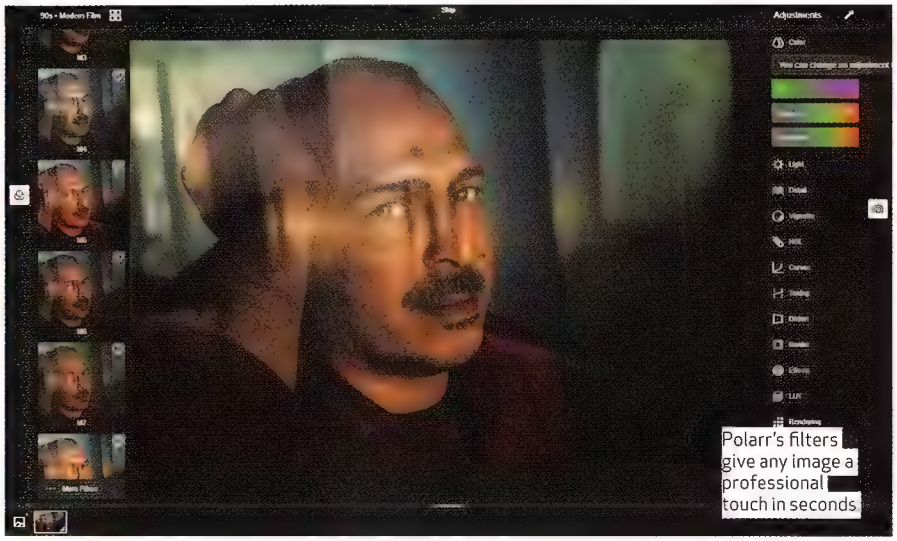
Free: that's the magic number. At least, it is when it comes to PC software. Why break the bank populating your PC with applications when enterprising individuals and organisations have created a raft of software that does the job adequately for not a single dollar down?

Now, we're well aware that there are several different categories of free software. There's the stuff that comes from the open-source community, which is usually a little rough around the edges, owing to its many-cooks approach. But open-source software has its own advantages: Sometimes it's home to experimental features that those in the commercial market might hold back on; sometimes it's designed for a niche that commercial developers can't profit from. There's also that slight guarantee that your software is going to stay free – while it might take an age to update and basically come with no warranty, open-source software suddenly attempting to dig around in your wallet is a rare occurrence.

The other side of the coin is "free" software, in quotation marks. There's a swathe of it in this list, but we've done our best to dodge anything too feature-light. Essentially, as has been the case for decades, software publishers often offer a taste of the goods in an effort to get you hooked enough to buy the real thing. Often, that taste is adequate on its own. Sometimes, it's not really a taste for you as much as it is for the business market, where expensive per-seat licenses can be a real money-spinner. You can have the software, but these guys need to pay.

Whatever the reason for a package being free (or "free"), we've tried to avoid picking out any time-limited trials or painfully poor options in this collection. There are 50 options for 50 distinct jobs – and 50 alternate suggestions, if our top pick doesn't give you exactly what you need. It is entirely possible to populate a PC with completely free apps – and a great many of these are cross-platform, so if you're really on the free side of the fence, you can run them on a Linux machine, too.

CREATIVITY


Polarr's filters give any image a professional touch in seconds

1 PHOTO EDITING
POLARR
http://polarr.co

Polarr has crept up on us over the past few years, but since it made the jump from mobile to PC app, it's proved to be one of the coolest and most capable photo-tweaking tools available, paid or not.
Alternately: Adobe Photoshop Express

2 IMAGE EDITING
GIMP
http://gimp.org

Stupid name aside, we've known for about a decade that Gimp's Photoshop-esque toolset and laundry list of filters make it an essential desktop tool. Save often, because it can decide to be flaky at a moment's notice.
Alternately: Pixlr

3 DIGITAL PAINTING
KRITA
http://krita.org

Best enjoyed with a pressure-sensitive tablet, but viable for anyone who wants to create art with a mouse, Krita is an surprisingly accomplished paintbox as perfectly suited to illustrators as it is to any budding Bob Ross.
Alternately: MyPaint

4 VECTOR ART
INKSCAPE
http://inkscape.org

Pixels be damned: With Inkscape, you can create entirely scalable graphics and tweak text to your heart's content, making it perfect for generating logos and such. Inkscape is analogous to Adobe Illustrator (although it's a whole lot more free), and it's also fully SVG compliant.
Alternately: Gravit Designer

5 MUSIC MAKING
CAKEWALK
http://bandlab.com

Back from the dead somewhat, Cakewalk recently came under new ownership – and those owners decided that the app was best given to the world for free. Pro-level recording, all the tools you need to mix and master tracks, not to mention a host of software instruments and effects.
Alternately: Ardour

LINUX: THE ALL-IN-ONE OPTION

One of the most beautiful things about Linux, besides its inherent freeness, is that people are able to package it up with all kinds of also-free software, and send the whole thing out in one big bundle. Given that it's (usually) possible to run a Linux installation in Live form (that is, without installing it and making a mess of your precious internal drives), this can be a good way to keep those rarely used utility packages at hand, or get your hands on a whole bunch of software all at once. So, pick up some USB sticks, get these apps installed, and be ready for anything.

#1 FOR PRIVACY
TAILS
http://tails.boum.org

When you're getting all clandestine, turn to Tails. It automatically routes everything through the Tor network, keeping your online activity private, and includes a bunch of cryptographic tools to ensure all of your data is as difficult to intercept as possible. It's also handy if you want to scrub something off a drive without directly using it.
Alternately: Whonix

#2 FOR DRIVE MANAGEMENT
GPARTED LIVE
http://gparted.org

For messing with drive partitions or attempting to fix partition table errors, GParted is a pretty essential app – and its Linux distro incarnation keeps things very simple, packaging it with a few very straightforward but powerful file manipulation tools and little else. Perfect single-serving distro fare.

https://gparted.org
GParted Live (Default settings)
Other modes of GParted Live
Local operating system in harddrive (if available)
Memory test using Memtest86+
Press [Tab] to edit options
Automatic boot in 25 seconds.
GNOME Partition Editor
Live images like GParted give you options when you load, and you can even install them alongside Windows if you're brave.

6 WRITING
FOCUSWRITER
http://gottcode.org/focuswriter

A beautiful, serene background image. The clickety-clack of a typewriter accompanying your keystrokes. You, your words, and no ugly distractions. If there's something you need to get written, you should forget big clumsy office apps: Keep it simple.
Alternately: Typora

7 GAME CREATION
GODOT
http://godotengine.org

While there are plenty of game engine options out there, they're often pretty demanding when it comes to eventual royalties; Godot is completely free and rapidly maturing, with Vulkan support on the way, and a huge swathe of documentation to get you started.
Alternately: Amazon Lumberyard

8 3D MODELING
BLENDER
http://blender.org

Blender recently ditched its game engine portion in order to focus on the features it really excels at: every step of the 3D pipeline. So, whether you're creating, sculpting, rendering, or animating, there's a tool here to help – and 17 years of maturity to back them up.
Alternately: 3D Crafter

9 DTP
SCRIBUS
http://scribus.net

There is no sense in trying to lay out complex documents in Microsoft Word, given its propensity to tear a hole in space-time whenever you slightly resize a text box. Scribus is a much more sensible option for desktop publishing, with a powerful text engine and strong image options.
Alternately: Lucidpress

10 ANIMATION
SYNFIG
http://synfig.org

Whether your 2D animation needs consist of tweening vectors or skeletally animating a collection of bitmaps, Synfig gives you the necessary tools. It's adept enough to produce some professional results – although the quality of your work is down to you....
Alternately: OpenToonz

Just because you can make vector images in Inkscape doesn't mean you should.

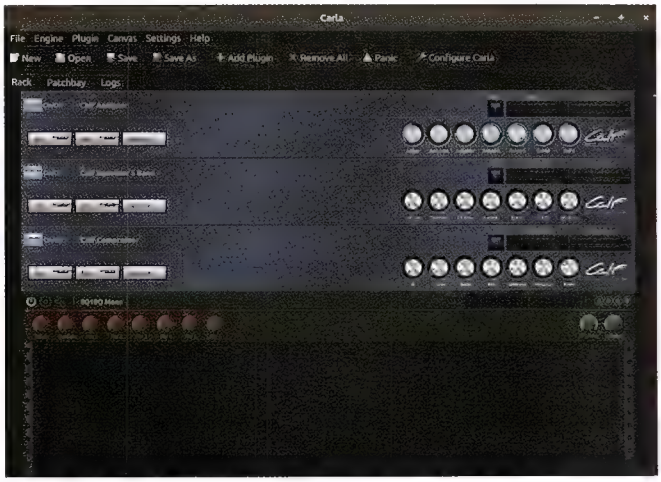
MEDIA

11 MOVIES
VLC
http://videolan.org

Other apps periodically vie for the crown, but we've never found another free player compatible with so many codecs and ready to cope with so many potential rendering glitches. Dig under the surface, and VLC can do a whole lot more – it's great for latching on to streaming services, too.
Alternately: MPC-HC

12 AUDIO
MUSICBEE
http://getmusicbee.com

Yes, iTunes is free. Yes, you can use iTunes if you like. But if you care about your system resources and want to organize your entire music library away from Apple's sticky


Carla
File Engine Plugin Canvas Settings Help
New Open Save Save As Add Plugin Remove All Panic Configure Carla
Rack Patchbay Logs
Fancy a virtual audio rack? Ubuntu Studio can provide just that.

Alternately: Clonezilla Live

#3 FOR YOUR MEDIA CENTER
OSMC
http://osmc.tv

An unofficial mesh together of the Debian Linux distribution, noted media center app Kodi, and some custom tweaks to make its interface as usable and simple as possible, OSMC is a great distro for that living room PC – or when you want to let someone watch some films on your PC without actually giving them full access to your files.
Alternately: LibreELEC

#4 FOR SECURITY TESTING
KALI LINUX
http://kali.org

How tough are your computers? How bad-guy-proof is your network? Find out with Kali Linux, which carries a huge package of tools to help the white hat hacker find vulnerabilities in existing systems. You'll need to know what you're doing, and make sure you use the tools properly to avoid a worrying knock on the door, but there's none better for testing security.
Alternately: BackBox

#5 FOR CREATIVITY
UBUNTU STUDIO
http://ubuntustudio.org

Whether you're interested in producing video or audio, Ubuntu Studio is bursting with tools to help. Its effectiveness will, given Linux's usual awkwardness, depend on the precise hardware you have installed, but it's free. That certainly makes it worth trying before investing in expensive pro production packages.
Alternately: AV Linux

grasp, MusicBee is a great (and skinnable) choice.
Alternately: Winamp

13 LIBRARY MANAGEMENT
PLEX
http://plex.tv
For a large video collection, a large audio collection, or even a huge photo library, keeping everything easily accessible is vital. Luckily, Plex can deal with streaming all your media, and makes getting to it from outside your network an absolute breeze.
Alternately: Kodi

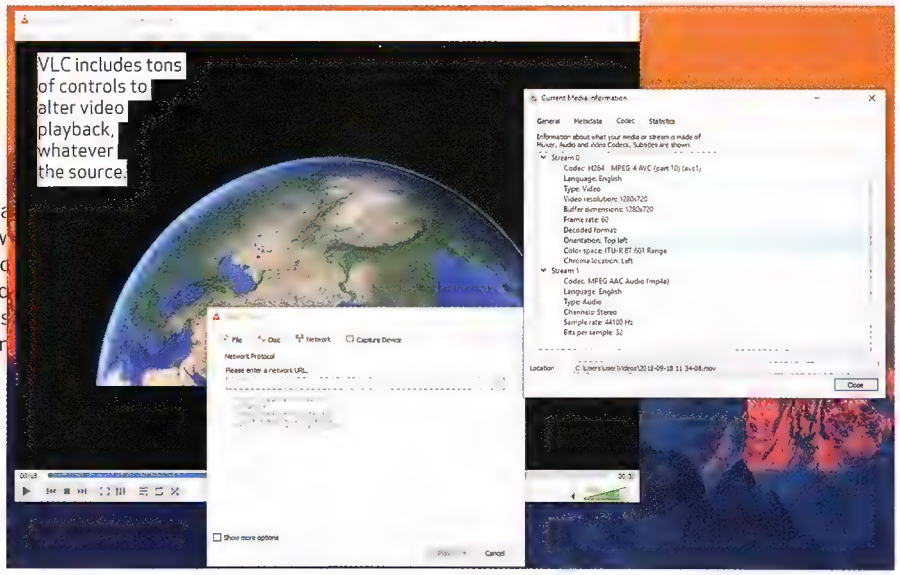
14 TRANSCODING
HANDBRAKE
http://handbrake.fr
HandBrake is a miserably ugly program. It's not easy to get started with. But once you've done the work, it's just about the most powerful video conversion tool there is – perfect for transcoding individual files or even large batches to the format you need.
Alternately: Freemake Video Converter

15 VIDEO EDITING
SHOTCUT
http://shotcut.org
Shotcut has been carving out its own niche in the video-editing world, and while it's still catching up to the big boys, it's also entirely free – no surprises, no restrictions.
Unless you look on the Microsoft Store, where it's inexplicably paid-for. Don't do that.
Alternately: OpenShot

16 VIDEO GRADING
DAVINCI RESOLVE
http://blackmagicdesign.com
You can just as easily use Resolve for editing, but its grading and post-production effects are its real strength. It's a professional tool that's seen use in numerous Hollywood productions, and the free version is perfect for color correction, too.
Alternately: Color Fixer Pro

17 AUDIO EDITING
AUDACITY
http://audacity team.org
Audacity almost annoys us: We're kind of desperate to recommend something different in this slot, but there's still nothing else that can hold a candle to it for audio cutting or tweaking. It's a tool that everyone should have installed at all times.
Alternately: Ocenaudio

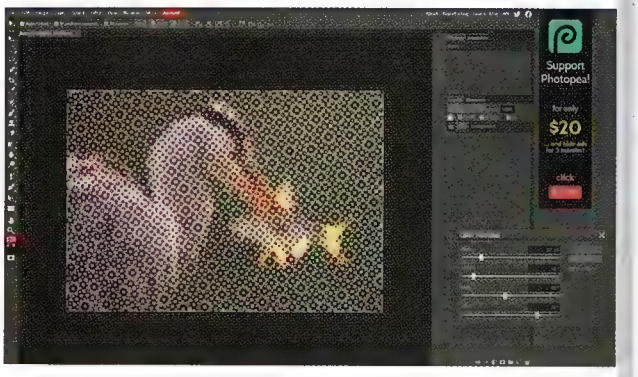
18 PODCASTS
GROVER
Via Windows Store
Styled to look a little like Groove Music



DO IT ONLINE

Fill your PC with software or take advantage of online tools? It's a tough one. In certain circumstances, this isn't an option – we don't know, for example, of an online tool that can help repartition your hard drive – but moving your work online does have a long list of advantages. Your files will theoretically always be where you left them. There's no need to manually update a piece of online software to keep it in line with the latest developments. And your local machine stays uncluttered and unslowed by the overheads of installed software. We might have presented a list of 50 programs, but we don't expect you to be mad enough to install them all.

There's an ever-growing string of online tools turning up. For the office, Google's Docs suite (**http://docs.google.com**) has matured to a surprising level of competence, and Microsoft's own Office Online (**http://office.com**) offers up a decent cut-down version of its desktop office tools, and integrates nicely with OneDrive. Want to edit photos? Photopea (**http://photopea.com**) is a Photoshop-esque image editor that, in some cases, even manages to do more than the software it's emulating – we even recommend it over GIMP, given that Photopea doesn't include "randomly crashing" among its list of hobbies. Many of the desktop tools that made our list also have an online component, and in some cases it's preferable over its installed counterpart. LastPass is best managed online, TeamViewer works great through its Chrome plugin, Spotify's web interface is a little stronger than its desktop version, and you can employ the services of **http://userstyles.org** to mess with the CSS and customise it to your liking.



Photopea is as capable of ruining your pics as any other app.

(which, we're sure, everyone is using at all times), Grover is a good way to manage podcasts if you're still doing it on your desktop. It's probably better than doing it through iTunes, at least.
Alternately: Juice

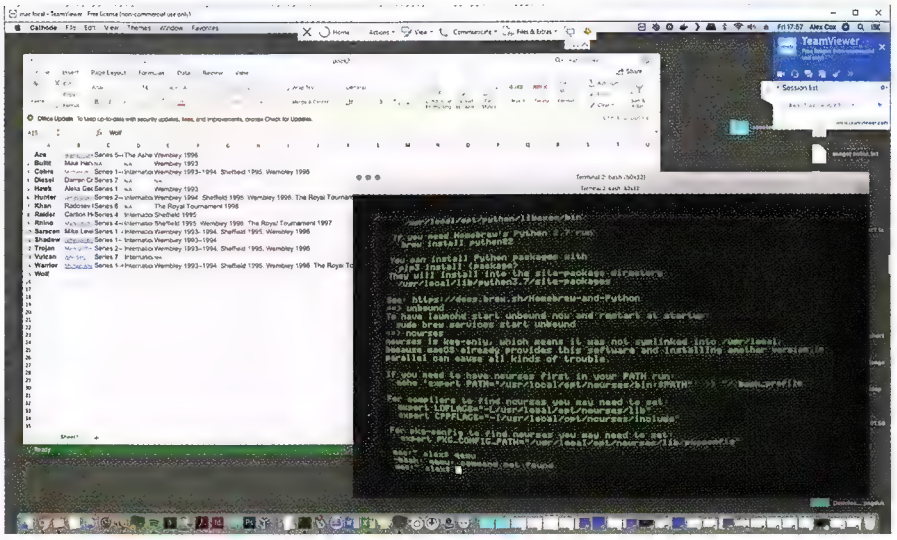
19 AUDIO STREAMING
SPOTIFY
http://spotify.com
You are spoiled for choice in the streaming market, but (despite its oppressive ads) Spotify's massive library and straightforward interface makes it our top choice – though the free tier forces you to listen to your playlists on shuffle.
Alternately: Deezer

20 ORGANISATION
THE RENAMER
http://therenamer.com
You've got lots of files. Videos, music, all from legitimate sources – but there's no consistency in naming or storage. Sort them out without the effort using The Renamer, which does exactly what you think it does.
Alternately: Bulk Rename Utility

WORKING

21 OFFICE
LIBREOFFICE
http://libreoffice.org
Pretty much a free equivalent to Microsoft Office, and compatible with the same file formats, LibreOffice is a non-paid essential. It even does more: There's a full database and a complex formula editor included.
Alternately: Apache OpenOffice

22 PDF VIEWER
FOXIT READER
http://foxitsoftware.com
Foxit's big selling points are its connected features, which tell you when a PDF has been scribbled on or tweaked, but we're backing it for its ability to open PDFs quickly without eating all of our system resources. That's not a big ask.
Alternately: Adobe Reader



TeamViewer's cross-platform abilities mean you can use it to control any other computer, even Macs.

23 EMAIL
EM CLIENT
http://emclient.com
While many of us manage our mail on the web these days, eM Client's free tier allows you to take desktop control of two accounts. It's fully compatible with the more complex features of Outlook and Gmail accounts, and super-easy to use.
Alternately: Thunderbird

24 SOCIAL
HOOTSUITE
http://hootsuite.com
Dig through the pricey corporate options and find Hootsuite's three-account free plan: You can schedule posts, manage multiple social services, and see your searches in their own live-updating columns. It's social taken to the next level.
Alternately: TweetDeck

25 COMMUNICATING
FRANZ
http://meetfranz.com
It's tough being connected. There's the family WhatsApp, the work Slack, the gaming Discord, that one guy who won't stop using ICQ for some reason. No problem: Mash them all together using Franz. You can even take your combined account between computers.
Alternately: Pidgin

26 TO-DO
MICROSOFT TO-DO
Via Windows Store
Microsoft's app is a superb way to list the things you're procrastinating on, the things you haven't quite done yet, and the things you won't do in a million years. Maybe, just maybe, you'll be able to check one off.
Alternately: Wunderlist

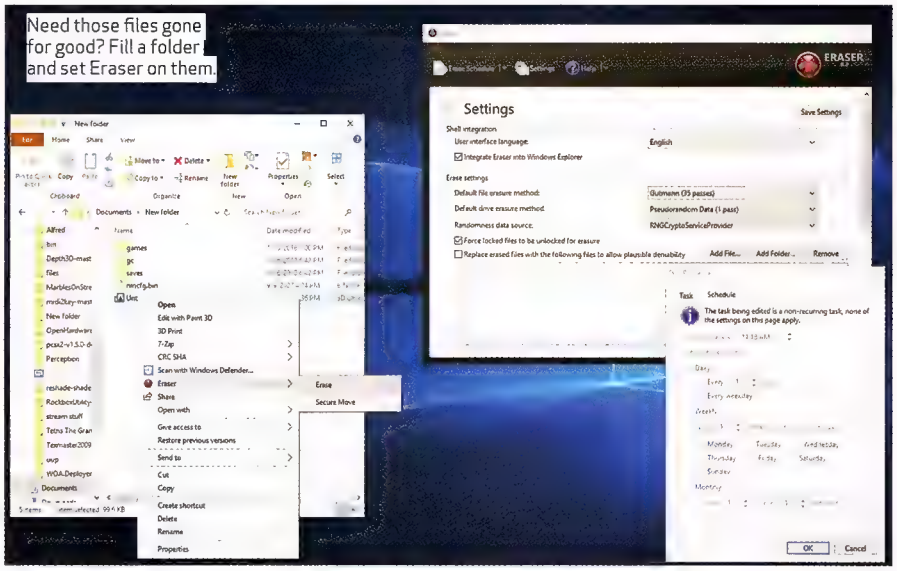
27 VPN
PROTONVPN
http://protonvpn.com
VPNs are essential. Problem is, the free VPN market is hampered by bandwidth restrictions. Not so with ProtonVPN – you can use its free version as much as you like; the annoyance is transferred to a speed limit instead.
Alternately: Hotspot Shield

28 REMOTE DESKTOP
TEAMVIEWER
http://teamviewer.com
How often have you tried to diagnose a technical problem over the phone and ended up bashing your head on your keyboard? No more. TeamViewer is easy to set up, super-secure, and can give you direct access to your desktop (or an elderly relative's) via a browser.
Alternately: TightVNC

29 NOTES
NOTEPAD++
http://notepad-plus-plus.org
There's a whole lot of contextual formatting in Notepad++ (it is, after all, made for sketching code in all manner of languages), but it's just as much a straightforward and capable alternative to Microsoft's Notepad. And that's a good thing.
Alternately: Atom

30 PLANNING
TRELLO
http://trello.com
Got a big project coming up? Put it on virtual notecards, pin it up on a virtual board, and spread those tasks out between everyone who you've roped in to help. Hopefully, they'll actually chip in, rather than just being virtually present.
Alternately: Evernote

FILES



31 UNDELETING RECUVA

http://ccleaner.com/recuva

No guarantees, but if there's a file that's gone to the big data graveyard in the sky, you may be able to convince it back to life with Recuva. Generally, deleting only removes the reference to the file, not the file itself: Recuva finds what's left behind.
Alternately: Undelete 360

32 DISK RESCUE TESTDISK

http://cgsecurity.org

Whole drive letting you down? Mechanical disk giving you the click of death? TestDisk can ignore all the usual safeguards and filesystems in order to wade through the raw data, sector by sector, giving you one last chance to rescue your files.
Alternately: Paragon Rescue Kit

33 DESTRUCTION ERASER

http://eraser.heidi.ie

As Recuva and TestDisk prove, deleting something won't keep it from the determined data sniffer. Eraser is the equivalent of a cross-cut shredder, securely overwriting files (or an entire drive) with your choice of destruction standard.
Alternately: BleachBit

34 MOVEMENT TERACOPY

http://codesector.com

Windows' copying procedures can leave a lot to be desired; if you're shuffling files from place to place, TeraCopy (which uses advanced buffering techniques) can do the job a lot faster and much more reliably.
Alternately: Ultracopier

35 MANAGEMENT MULTI COMMANDER

http://multicommander.com

Whether you come from the era when it was popular or not, the Norton Commander-style two-pane file management of Multi Commander is a natural and highly efficient way to move files and folders from one place to the other.
Alternately: FreeCommander

36 ARCHIVING 7-ZIP

http://7-zip.org

Do away with that 2,000-day expired shareware version of WinRar: 7-Zip supports way more than just .7z archives, and it's free. Whether compressing or decompressing files, it's an essential component of any good Windows install.
Alternately: IZArc

37 PREVIEWING XNVIEW MP

http://xnview.com

XnView MP is a great way to preview images, taking you beyond the "extra large icons" school of picture glimpsing to a quickly browsable and logical graphical interface – you can use it for batch processing or conversion, too.
Alternately: IrfanView

38 EXPLORING TABLACUS

http://tablacus.github.io

Quite why Windows Explorer doesn't have tabs in 2019 we don't know, but Tablacus solves that problem: It's a file manager that, yes, includes tabs. It also lets you tile folders in panes, and disable any components you don't need.
Alternately: XYplorer

39 CLOUD STORAGE ONEDRIVE

http://onedrive.com

The integration of Microsoft's cloud platform with Windows makes it a top choice merely for ease of use – there's basically nothing to set up. It may not have the largest capacity, but where other integrations falter, OneDrive will be standing tall.
Alternately: Mega

40 UNINSTALLING IOBIT UNINSTALLER

http://iobit.com

Oh, sure, Windows can uninstall software. But how thorough is it? Does it hunt through your drive to find every associated file? Does it fully scrape that space clean? IObit's neat program ensures that removed apps are actually removed the right way.
Alternately: Geek Uninstaller

SECURITY

41 BACKUP COBIAN BACKUP

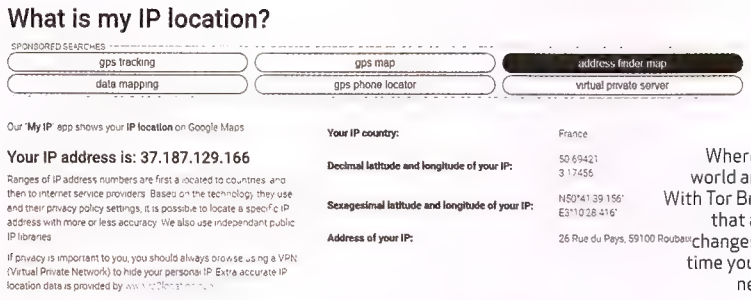
http://cobiansoft.com

Cobian Backup is one of the most capable free backup packages there is. Send your files off to an external drive, send them to a network location, send them to an FTP server: whatever works.
Alternately: EaseUS Todo Backup

42 PASSWORD MANAGEMENT LASTPASS

http://lastpass.com

There are plenty of solutions for managing your precious passwords, but LastPass wins points for the generosity of


What is my IP location?
SPONSORED SEARCHES
gps tracking
gps map
address finder map
data mapping
gps phone locator
virtual private server
Our 'My IP' app shows your IP location on Google Maps
Your IP address is: 37.187.129.166
Ranges of IP address numbers are first allocated to countries and then to internet service providers. Based on the technology they use and their privacy policy settings, it is possible to locate a specific IP address with more or less accuracy. We also use independant public IP libraries.
If privacy is important to you, you should always browse using a VPN (Virtual Private Network) to hide your personal IP. Extra accurate IP location data is provided by
Your IP country:
France
Decimal latitude and longitude of your IP:
50.69421
3.17456
Sexagesimal latitude and longitude of your IP:
N50°41'39.156"
E3°10'28.416"
Address of your IP:
26 Rue du Pays, 59100 Roubaix

Where in the world are you? With Tor Browser, that answer changes every time you visit a new site.

its free offering – there are a few desirable features as part of its paid offering, but nothing essential.
Alternately: Dashlane

43 SYSTEM CLEAN-UP
CCLEANER
http://ccleaner.com

CCleaner does all those long, laborious clean-up tasks in one place. You can either run a selective scrubbing job, or set up a batch job to deal with everything at once. Just be wary of the pop-ups.
Alternately: Advanced System Optimizer

44 ANTIVIRUS
BITDEFENDER FREE EDITION
http://bitdefender.com

Many free antivirus packages are not worth the drive space they're written on. Bitdefender is: It's not too heavy on the hassle, includes a quality AV engine with frequent updates, and a slick interface.
Alternately: Windows Defender

45 POST-INFECTION
SPYBOT SEARCH & DESTROY
http://safer-networking.org

Install pre-emptively: If you suspect something untoward is on your system, Spybot is likely to be able to hunt it down and exterminate it.
Alternately: Malwarebytes

46 ENCRYPTION
BOXCRYPTOR
http://boxcryptor.com

Do you trust your cloud storage provider? Enough to store your most personal files online without obfuscation? Probably not. But with Boxcryptor, you can construct an encrypted storage area – and if the provider encrypts, it's double safe.
Alternately: VeraCrypt

47 INTERNET PRIVACY
TOR BROWSER
http://torproject.org

Routing your Internet traffic via Tor makes you very difficult to track, and helps you resist online fingerprinting. The Tor browser makes doing so incredibly easy.
Alternately: Iridium Browser

48 NETWORK MONITORING
AXENCE NETTOOLS
http://axence.net

A full suite of 10 network tools, from monitoring to scanning to tracing routes. There's even a little cheeky internal Windows tomfoolery, all spun off from Axence's pro-level IT management suite.
Alternately: PRTG Network Monitor

49 NETWORK TROUBLESHOOTING
WIRESHARK
http://wireshark.org

A bit heavyweight, but Wireshark does its job so well that we have to recommend it. If you want to know what's going on with your network and why a function won't play ball, it's the most accomplished protocol analyser around.
Alternately: Colasoft Capsa

50 FIREWALL
TINYWALL
http://tinywall.pados.hu

Don't rely on your router, or even Windows, to do the job of batting back misbehaving packets, or stopping snoopers from probing your ports. TinyWall is super-lightweight and makes for a useful additional line of defense.
Alternately: ZoneAlarm Free

DON'T CHEAP OUT

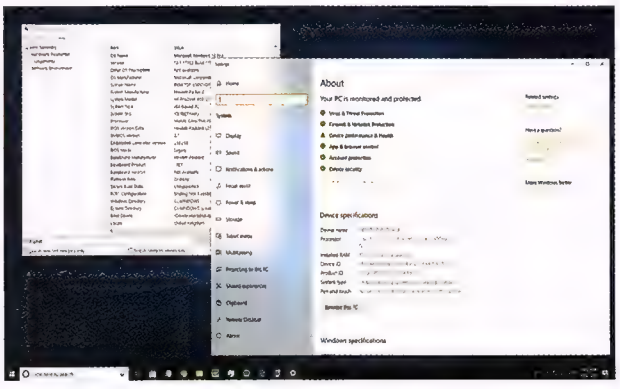
Hear us out as we use this box in an article about free apps to tell you not to use them: Sometimes it pays to pay. Sometimes a free package can't do the exact thing you want – if you're interacting with a business with very precise standards, a document that, say, LibreOffice produces might have subtle differences that make it look terrible on that company's Microsoft Office-packing machines. An open-source package comes with no guarantees, no support, no comeback if everything goes wrong. It might have a forum full of enthusiastic amateurs and some official-looking documentation, but it doesn't have any guarantee of professionalism.

If it's mission critical, don't rely on free software.

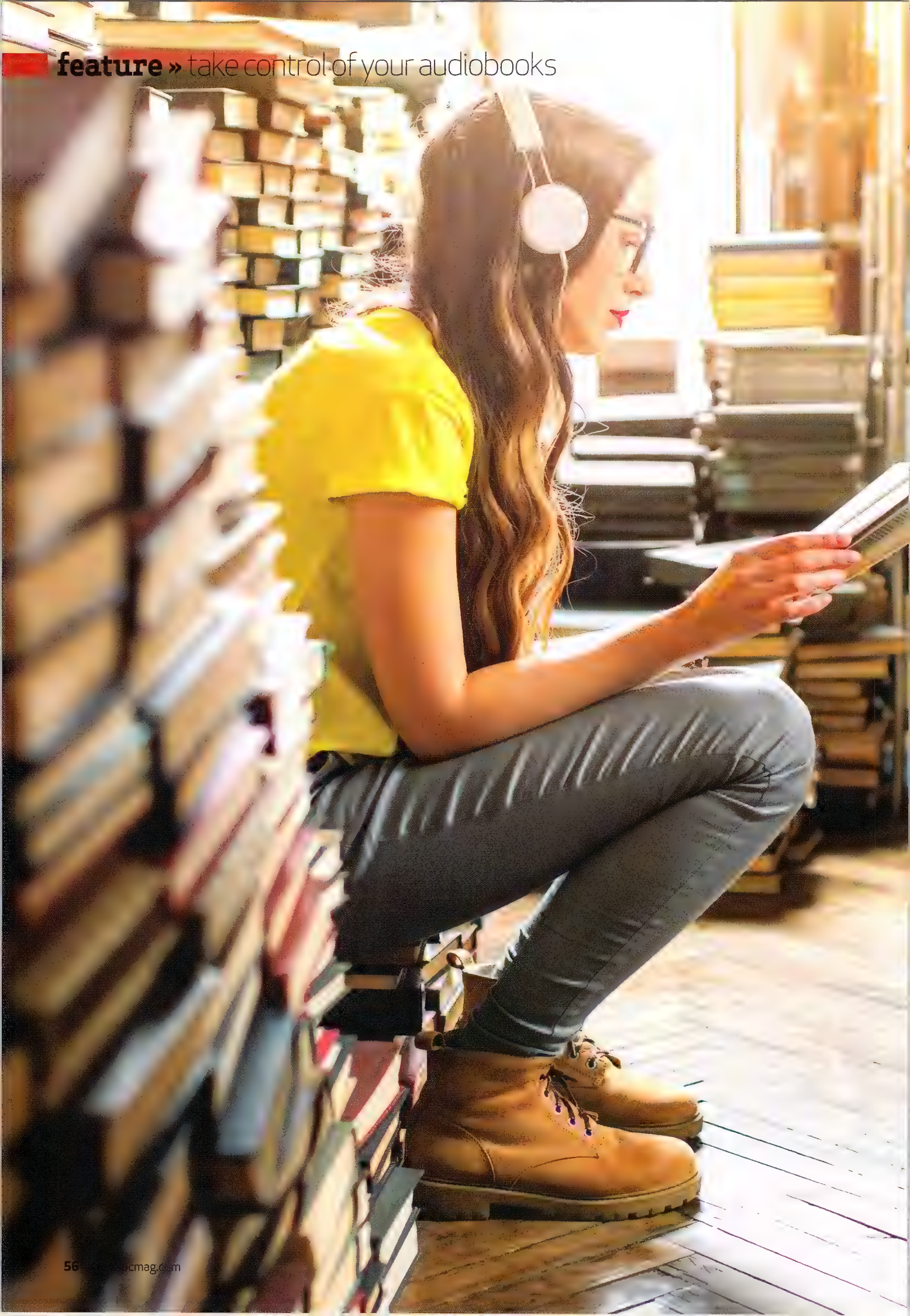
Often, free apps either lack critical features (many exist simply to tease a paid upgrade) or can't keep up with the quality of their paid-for alternatives. For instance, while we've recommended ShotCut as a free video editor, it is nowhere near as complex or well built as something like Adobe Premiere.

Even Cakewalk, our pick for free audio recording and editing and a formerly paid-for app, isn't the best choice in its sector because it's a little behind the curve.

Then there's the niche apps for which there is no free alternative, and you should also consider Windows itself – while we put our weight behind experimenting with Linux, it is not, for most, a production OS. Windows is rock solid, compatible with just about everything, has a huge software library, and despite the fact that you can run it in a chopped-down unactivated mode, you really should pay for the license, or at least attempt to transfer an old Win 7 license up the chain. ■



Windows is worth the cash, unless you're truly ready for Linux.



TAKE CONTROL OF YOUR AUDIOBOOKS

Rip, convert, and stream your audiobook collection to any device, with Nick Peers.

When it comes to media, your PC has everything covered, right? There's Kodi, Plex, or Emby for starters, managing your music, movies, and TV with aplomb. Except there's something missing...

Everyone loves a good story, and audiobooks (along with radio-style dramatisations) provide an easy way to devour books when focused on other tasks, whether driving long distances or tweaking your PC's hardware. The obvious place to go for an audiobook fix is Audible, but it ties you into a proprietary ecosystem that requires you to purchase your books outright via one-off fees or a recurring subscription. Furthermore, you're indebted to Audible's own apps and servers for accessing your books. That's fine if you're a fan of paying for streaming services, but the likes of Plex, along with audio-only services such as Logitech Media Server, enable you to stay in complete control of your media, so why shouldn't that be the case with audiobooks? There's no reason. You can incorporate your audiobook collection into existing streaming services, but none of them quite hits the mark. Which is where we come in to help!.

In this exhaustive guide, we'll start by bringing all your audiobooks – whether CD, free downloads, or purchased through Audible – under one roof. You'll rip CDs exactly the way you want your books divided up, then tag your files consistently (complete with high-quality embedded artwork) to make browsing, managing, and listening to audiobooks a pleasure.

Once your media is in place, we'll reveal how to set up a dedicated audiobook server on your PC or NAS, enabling you to stream your audiobooks to any device in your home – or further afield if you want access on the go over the internet. There's even offline access through your cell phone should you wish to be able to listen to your books in the most remote spots.

We've spent months developing this project, experimenting, tweaking, and tearing our hair out so you don't have to. It's time to give your audiobook collection the prominence it deserves, so simply turn the page to put our carefully crafted research to good use.

Your first step is to bring all your audiobooks under one digital roof. Start by creating a single folder – "Audiobooks" – somewhere accessible, such as inside your Music folder. Inside here you'll store your audiobooks using the following folder structure: Collection\Author\Book. In other words, each book has its own folder, inside which your audiobook can be housed in multiple files (such as individual chapters, episodes, or parts), to aid navigation and playback.

As an aside, the Collection folder level is optional, designed to work with your audiobook server's support for multiple users, so you can restrict access to books on a per-user level. More on that later.

Next, you want to migrate all your audiobooks into this folder structure. If you're an Audible user (past or present), check out the box below on using OpenAudible to download DRM-free MP3 copies of your purchased books to incorporate into your new setup.

You can also obtain audiobooks from other online sources – books in the public domain (typically out-of-copyright classics) have been narrated by volunteers and placed on various websites, many of which have been produced by LibriVox, so head to **https://librivox.org** to browse its catalog. Choose the "Whole book (zip file)" option to download the book as a series of MP3 files, one per chapter. Each file is tagged with author, title, and other key details, and you can also download cover art to embed into the files. More on verifying those tags and embedding the artwork later. For now, once downloaded, extract the contents of the zip file into your Audiobooks folder according to your folder structure: for example, Audiobooks\Classics\Herman Melville\Moby Dick.

RIP YOUR AUDIOBOOK CDS

Another way to add audiobooks to your library is to rip them from CD. We recommend iTunes (install it through the Microsoft Store) for three reasons: It has a built-in audiobook library to avoid cross-contamination with your music; its CD lookup database includes many popular audiobooks, from *Harry Potter* to Stephen King; and it can join multiple tracks into a single file when ripping. This helps mitigate those audiobook CDs split into very short tracks to make them easier to navigate on CD players.

After installing, open iTunes, and insert your first audiobook CD. After a short pause, you'll hopefully see the "CD Lookup Results" dialog appear, with at least one match to choose from. Select the first in the list, and click "OK." Review how it's named each track – ideally, you'll see the chapters clearly marked, but if not, click the "Options" button (the cog next to the eject button), and choose "Get Track Names" to choose another from the list.

If you can't tell which tracks correspond to specific chapters, double-click a track name to start playing it, to see if the chapters are spoken at the start of a track. Once identified, select all the tracks that make up chapter one, click "Options," and select "Join CD tracks" – you'll see the selected tracks are now all linked to indicate they'll be ripped as a single file. Repeat for other chapters on this disc.

Before ripping, click "CD Info" to review the audiobook's key metadata – you'll also need to click this to manually enter the information if the CD lookup database found no matches. Verify the "Artist" is the author, and if necessary, tweak the audiobook title in the album field – or "album" name if it refers to multiple discs or parts. This needs to be identical across all the audiobook's discs to ensure they're ripped to the same folder. Use the "disc number" fields to specify the disc number. If the genre is currently set to "Spoken & Audio," change this to "Audiobook," unless it's a dramatisation rather than a straight reading. Finally, verify the compilation box is unchecked before clicking "OK" followed by "Import CD."

The "Import Settings" box pops up. Select "MP3 Encoder" for the "Import Using" box, and click "Custom" under

DOWNLOAD AUDIBLE BOOKS

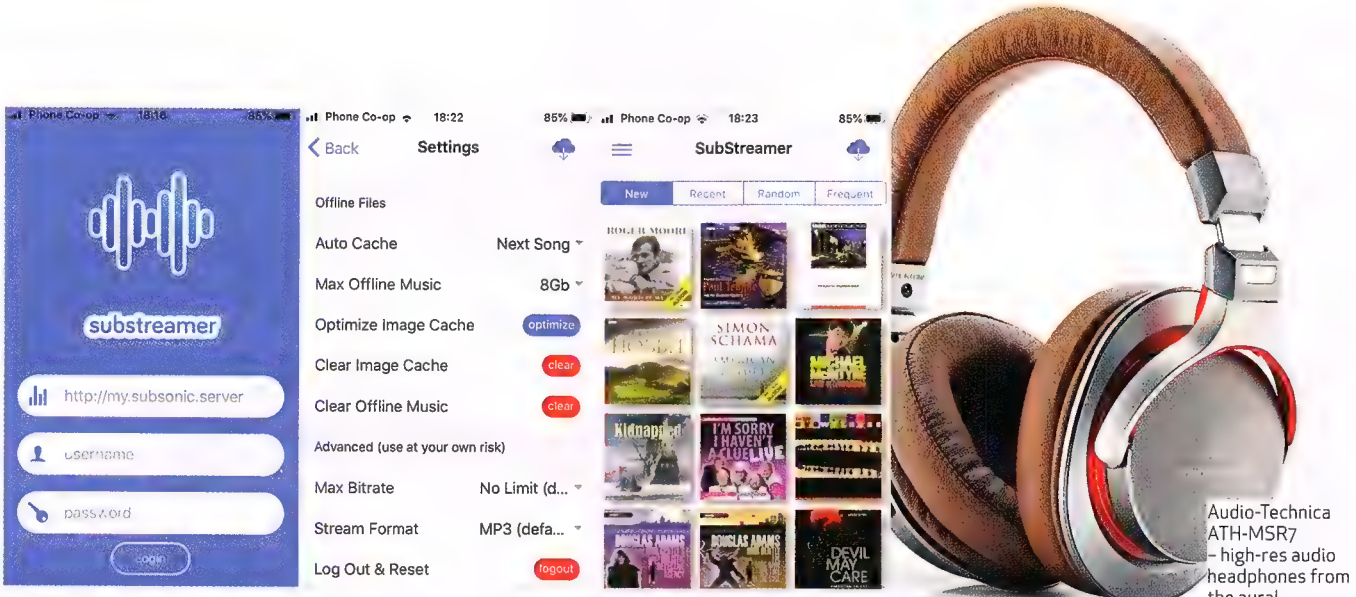
To add your Audible collection to your new DRM-free audiobook collection, you need OpenAudible, a tool for managing and downloading Audible books you own to your PC. Head over to **https://openaudible.org** to download the setup file. Launch it, clicking "More info > Run anyway" when the SmartScreen filter pops up. Once installed, launch OpenAudible, and press Ctrl-k to connect to your Audible account using OpenAudible's built-in browser. Close the window and, if necessary, press Ctrl-k to connect again, then choose "Controls > Full Library Sync" to view all your previous purchases in the main OpenAudible window.

By default, all downloaded audiobooks are converted to MP3 (verify this via "Edit > Preferences"). To download a single audiobook, right-click it in the lower pane, and choose "Download." Keep an eye on the "Audio Book Info" pane, which tracks the progress of the download and conversion.

OpenAudible downloads audiobooks as single files – if you want to divide them into parts, choose "File > Split by Chapter." Browse to C:\Users\{username}\OpenAudible\mp3 (substitute {username} with your username), where you'll find all the converted files. Select one and click "Open," then select your main Audiobooks folder, and create

the required Author/Title subfolders before selecting the Title and clicking "OK." If Audible has chapter data, your files are split accordingly.

Once complete, switch to MP3Tag, and follow the advice in the main text to renumber the tracks correctly, then automatically retitle and rename each file according to how you want to do so (such as "Chapter 01" or "Part 02"). Finally, the artwork has only been embedded into the first title, so select title 1, right-click the artwork, and choose "Copy cover." Now select the remaining titles, right-click the artwork again, but this time choose "Paste cover" before clicking "Save."



The SubStreamer app for iPhone works beautifully with Booksonic servers.

Audio-Technica ATH-MSR7 – high-res audio headphones from the aural heavyweight.

"Setting." Audiobooks don't require top-quality settings, so minimise the space they take up by setting the "Stereo Bit Rate" to 64kb/s. Leave the other settings as they are and click "OK" twice. Wait for the disc to be ripped, then repeat for any other discs in the audiobook set.

JOIN CHAPTERS

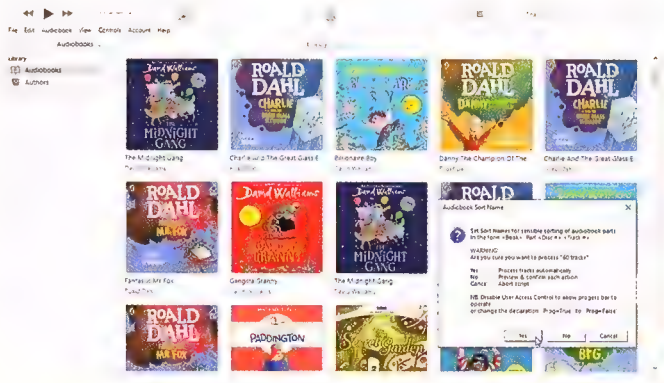
If you're ripping a multi-disc audiobook, there's a good chance some chapters will be split across two discs. You can either leave them as they are (say Chapter 10a and Chapter 10b) or use a tool such as Free MP3 Joiner (**www.convertaudiofree.com/free-mp3-joiner.html**) to combine them into a single file. Free MP3 Joiner is a tiny portable tool that doesn't reconvert the files – it just stitches them together. Launch the app, then click the first "Browse" button to select the file containing the first half of the chapter before clicking the second "Browse" button to select the second half. Finally, choose a suitable output name (such as "Chapter 10"), and click "Join." Once complete, click "Open Output folder" to verify the new file exists alongside the original two, which you can now delete.

By default, iTunes rips all CDs to its own iTunes\iTunes Media\Music folder. Navigate here to find a folder named after your audiobook's author. Open this to reveal the audiobook folder, which you should move to the Audiobooks\Collection\Author folder you made earlier.

TAG YOUR AUDIOBOOKS

Once you've ripped your first audiobook, you need to tidy up the tags. Because audiobooks use the same tagging system as your music files, you

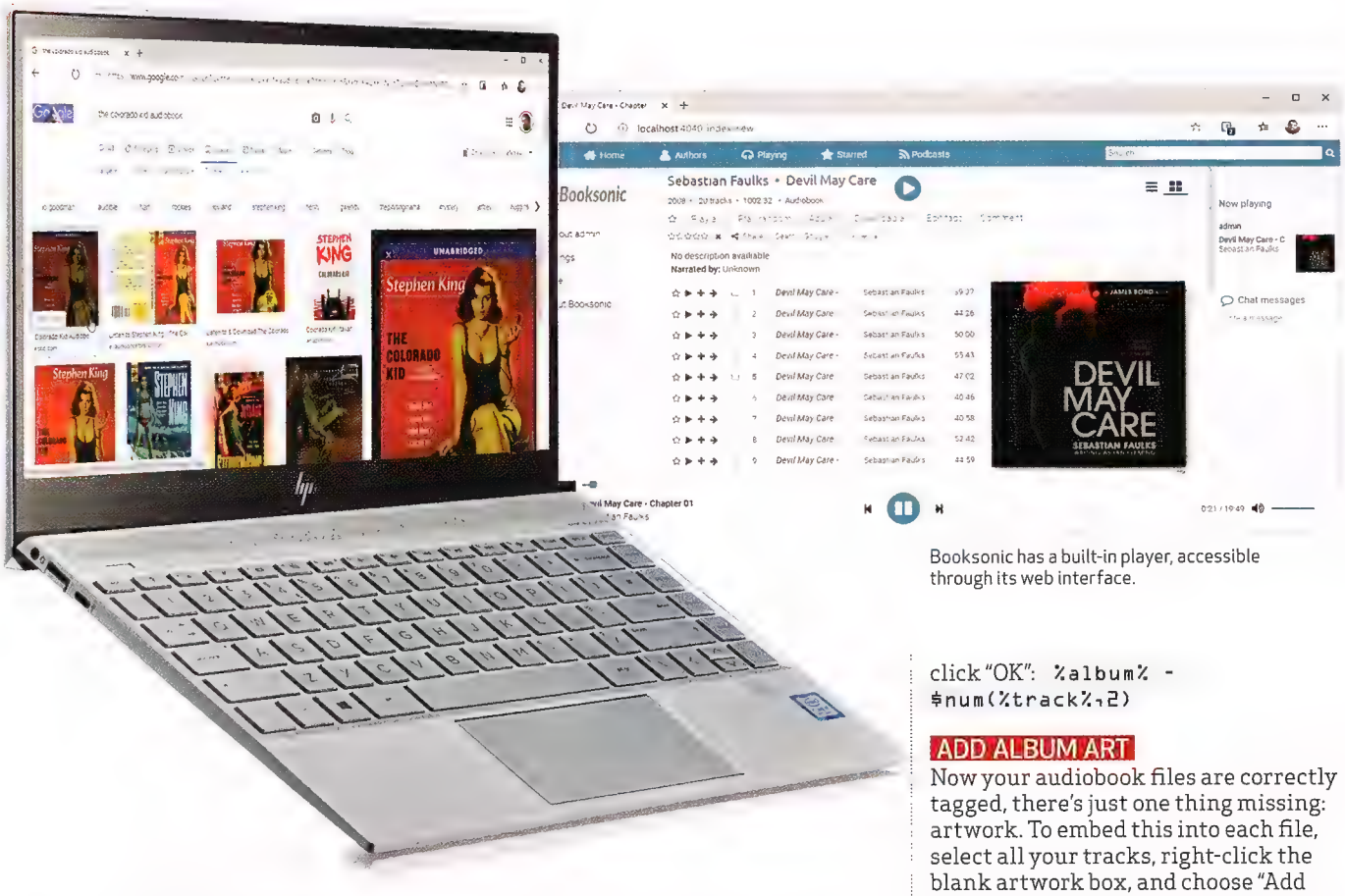
BUILD A LOCAL AUDIOBOOK LIBRARY



Having brought all your audiobooks together, now all you need to do is play them. If you only plan to listen to them on your PC, both iTunes and MusicBee (**https://getmusicbee.com**) offer dedicated audiobook views, enabling you to not just split your audiobooks from your music files, but also take advantage of specific audiobook features, such as the ability to pick up from where you left off during playback.

If you plan to go down the iTunes route, we recommend moving the Audiobooks folder back inside the default iTunes Media\Music folder. After being added to your iTunes library, you'll find them automatically classified as music. You can move them across by right-clicking a title (or titles) and choosing "Get Info > Options tab." From here, change its "Kind" to "Audiobook." It then vanishes from the Music library (switch to Audiobooks view to get it back). Sadly, the way iTunes works is to sort the audiobook library by title, so multiple entries for each audiobook will appear. To fix this, download the AudiobookSortName script from **http://samsoft.org.uk/iTunes/scripts.asp** – once done, select all your audiobooks in iTunes, then double-click the script. Click "Yes," and wait for a minute or so for it to perform the sort silently in the background. If your security software protests, you should either allow the script to run, or temporarily create an exception for C:\Windows\System32\wscript.exe.

MusicBee also has a dedicated audiobooks view – after adding your audiobook folder to the library, you need to right-click each author or narrator in turn, and then choose "Send to > Audiobooks" to transfer them to MusicBee's Audiobooks view. The primary advantage of doing this is that MusicBee will remember where you stopped listening to an audiobook, and then pick up from where you left off the next time you open it.



Booksonic has a built-in player, accessible through its web interface.

have to "translate" author and narrator information to the correct music-based tags. First, you need a tagging tool – our go-to app is MP3Tag, which you can download and install (or run as a portable app) from **www.mp3tag.de/en**.

Launch MP3Tag and browse to Audiobook\Collection\Author. Highlight your audiobook folder and click "Select Folder" to open it. All your ripped files should appear in the main pane. Start by reviewing the universal tags in the left-hand pane: Select all the tracks and ignore "Title" (which says "<keep>," indicating it contains multiple variables for each individual file). Instead, focus on "Artist," "Album," "Album Artist," and "Composer." We recommended putting the narrator's name in the "Artist" field, and the author's name in the "Album Artist" and "Composer" fields. Verify the "Album" is the book's title. Make any amendments, change the "Discnumber" field to "<blank>," and click the floppy disc icon in the top-left to save your changes.

You can now turn to the files that make up your audiobook. Start with the "Track" field in the main pane (scroll right to access it) – this needs to be renumbered sequentially from top to bottom, and the quickest way to do this is to select all your tracks, then choose "Tools > Auto-numbering wizard." Make sure "'Tracknumber" is checked and it's set to begin at track number 1, then click "OK."

Now review the "Title" field. Each title is an amalgamation of the titles of tracks you've joined. To change this manually, click inside the first title, then type your replacement title, and press Enter to move on to the next title. If, however, you simply want to name each title for its component chapter (Title-Chapter 01, Title-Chapter 02, and so on), speed things up by creating a custom action.

Select all your tracks and choose "Actions > Actions." Click "New," name your action group "Quick chapter titles" or something similar, and click "OK." Click "New" again, and choose "Format value" as your action type, followed by "OK." Select "TITLE" for the field, and type the following into the "Format string" box before clicking "OK":

```
%album% - Chapter
$num(%track%,2)
```

Click "OK" again to return to the "Action groups" window, check "Quick chapter titles," and click "OK." You'll see each title renamed accordingly: Book title- Chapter 01, Book title-Chapter 02, and so on. Don't want the leading zero? Type `%title% - Chapter %track%` into the "Format string" box instead. The action can be duplicated and modified to replace "Chapter" with, say, "Episode" or "Part."

Finally, we want to rename the file names. We're using the convention "The Colorado Kid-01.mp3," "The Colorado Kid-02.mp3," and so on. Make sure all the tracks are selected, then choose "Convert > Tag-Filename." You're prompted to select a Format string- type the following into the box, and click "OK": `%album% - $num(%track%,2)`

ADD ALBUM ART

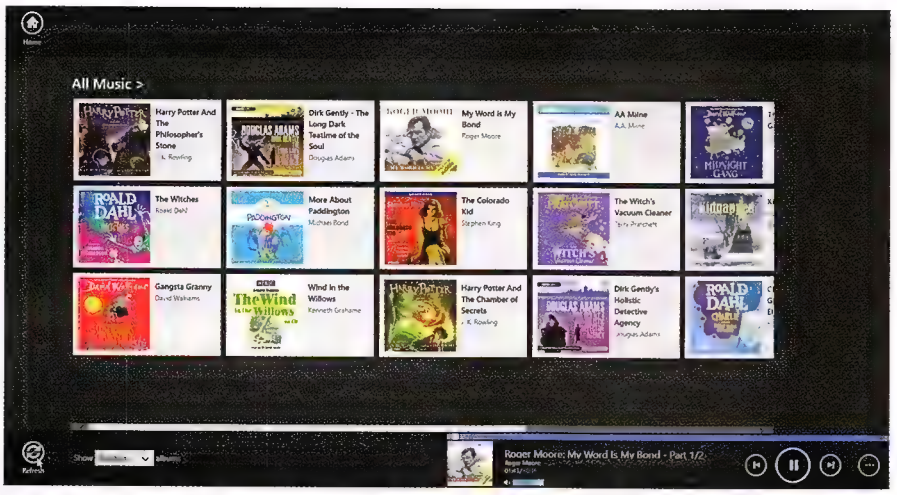
Now your audiobook files are correctly tagged, there's just one thing missing: artwork. To embed this into each file, select all your tracks, right-click the blank artwork box, and choose "Add cover." Once selected, the artwork should appear in the box, at which point click "Save."

We recommend adding a square image in JPEG format of the audiobook's artwork that's 600x600 pixels. Where can you get this? You could scan in your CD cover, or look online at **https://images.google.com**; type the title of the book along with "audiobook" and see what comes up. Click "Tools," then "Size > Large" to filter out smaller images, then roll over each result to see what size image is available. Click one, then right-click it, and choose "View image" to bring it up in your browser. Save this to your Downloads folder, then open it in an image editor if necessary, to reduce its size to 600x600 before saving it in JPEG format, ready to embed into your file.

BUILD YOUR AUDIOBOOK LIBRARY

While it's possible to keep your audiobook library on a single PC – see the box on building a local library – where's the fun in that? Booksonic (**http://booksonic.org**) is an audiobook streaming server that enables you to stream audiobooks to any device on your network. It's a fork of Subsonic, a well-known music streamer, so it can be used on a wide range of devices, including Android (Booksonic app, $3), iOS (SubStreamer, free), and Windows (MusicBee – see box, previous page).

Your main choice is where to install the server: There are installers for Windows and Linux if you want to host it on your


All Music >
Harry Potter And The Philosopher's Stone
Dirk Gently - The Long Dark Teatime of the Soul
My Word is My Bond
AA Milne
The Witches
More About Paddington
The Colorado Kid
The Witch's Vacuum Cleaner
Gangsta Granny
Wind In the Willows
Harry Potter And The Chamber of Secrets
Dirk Gently's Holistic Detective Agency
Roger Moore: My Word Is My Bond - Part 1/2

Supersonic is a native Windows client for accessing your Booksonic collection.

PC, or you can install a Docker image (**https://hub.docker.com/r/linuxserver/booksonic**), as we did on our QNAP NAS via Container Station. Setup is simple on Windows: Run through the installer and it's in place, set to auto-start with your PC. Right-click its system tray icon and choose "Booksonic Control Panel" to start or stop it, and enable https for a secure connection (via port 4443 by default).

The Docker image comes with a full set of configuration instructions – on our QNAP, we copied our Audiobooks folder into the NAS's shared Media folder, and created two "Volume from host" instances under "Shared Folders" for /config pointing to Container/booksonic/config and /audiobooks pointing to /Media/Audiobooks respectively. We also chose to point /config to Container/booksonic/config. Other than mapping port 4040 from the host to the container under Network, that was it.

CONFIGURE BOOKSONIC

Once set up, log into the Booksonic web interface: Open your browser and type "localhost:4040" if you installed it on your PC, or "192.168.x.y:4040" (substituting "x.y" with the correct part of your NAS's IP address). You'll see a login screen – enter "admin" for username and password, and click "Log in." Read the "Getting Started" message and click ≡ to reveal a slide-out menu. Choose "Settings > Users tab" and pick "admin" under "Select user." Check "Change password" and enter a new, strong password before clicking "Save." You'll be logged out – log in with the new password, then follow the advice in the final box to finish configuring the server.

Now you can switch attention to your clients – Subsonic desktop clients are thin on the ground (try Supersonic from the Windows Store), but you can access and play through your web browser or install a mobile app, such as the official Booksonic app on Android or SubStreamer on iOS.

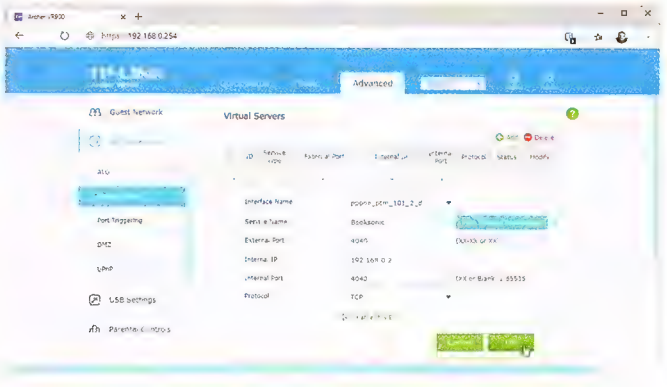
Taking SubStreamer as an example, on first launch, enter your server's URL plus port number (so "192.168.x.y:4400" for internal-only connections), and your username and password, and it connects, downloads data from your library, and enables you to browse and listen to it through a slick user interface – when prompted, click "Run Now" to perform a one-time optimisation. You can browse your library, play back from any title, and download books for offline access. You've created an Audible alternative that works with all your audiobooks, and is accessible from just about anywhere – well done! ■

CONFIGURE YOUR BOOKSONIC SERVER

To start configuring Booksonic, visit "Settings > Media folders" to specify where your audiobooks are stored. This is where you can take advantage of Booksonic's support for multiple users, dividing up your library into subfolders, then creating separate libraries for each. Click "Save" to enable your changes, and "Scan media folders now" to start populating Booksonic with your books.

Once done, switch to the "Users" tab to create individual profiles for other people in your household (or further afield if you're opening access to the Internet). Configure individual levels of access – including which libraries they can use – and set a bit rate if you're worried about bandwidth. Finally, click "Save." Users can then log into Booksonic with their own account, and configure things via the "Personal," "Players," and "Shared Media" tabs.

To see how your library is shaping up, click the "Home" link, where you'll eventually see them appear in all their glory, artwork intact. Click one to view it up close – here you'll find "No description available" and "Narrated by: Unknown" fields appearing above the artwork. To fix this, place your descriptive text in a file called "desc.txt" and the narrator's name in a file called "reader.txt" – both of which you store in the book's folder.



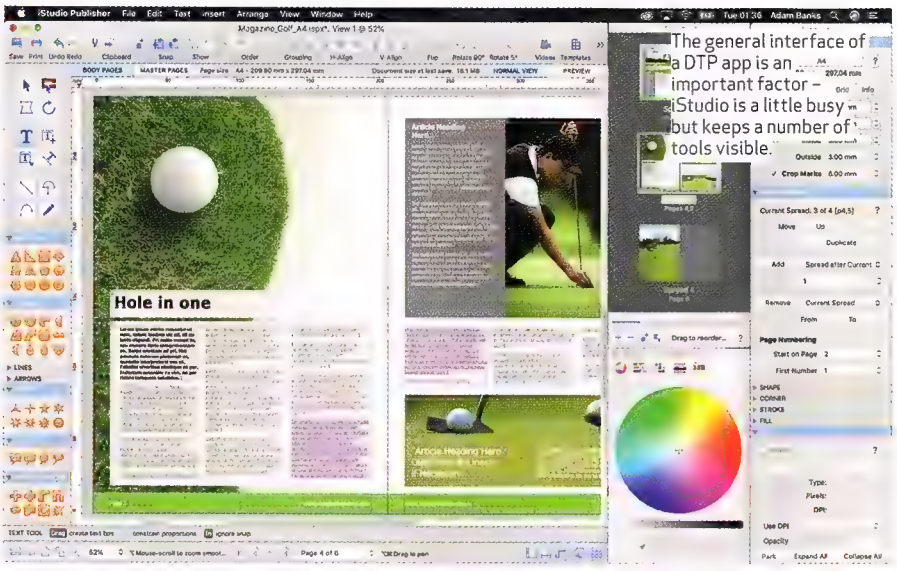
Finally, your Booksonic server is accessible anywhere on your home network, but you can open it up for Internet access, too. You need a dynamic DNS address, such as the free options offered at www.noip.com, then configure your router to forward port 4040 to your server's IP address. If UPnP is enabled, visit "Settings > Network" in the Booksonic web interface to try automatic configuration; you'll also find a link to **https://portforward.com** if you need router-specific instructions for setting up port forwarding manually. Once done, point your mobile app at **http://yourname.ddns.net:4040** to access it from anywhere.

THE BEST DESKTOP PUBLISHING APPS FOR MAC

You needn't spend a fortune to lay out pages and format documents better.

Reviewed by ADAM BANKS

Affinity Publisher
File
Edit
Document
Text
Table
View
Window
Help
HEYL
We offer a range of uniquely crafted reclaimed furniture. Our range of industrial reclaimed furniture can help you to achieve a modern, classic or rustic look. From reclaimed wood tables to chairs and much more, we have reclaimed furniture to cater to all of our customers' tastes.



The general interface of a DTP app is an important factor – iStudio is a little busy but keeps a number of tools visible.

Page layout is a task we all attempt from time to time, yet desktop publishing software is a relatively neglected category. If you've never delved into Adobe InDesign or QuarkXPress, you should see what you're missing. And if you have used the high-end heavyweights but baulk at their prices – over $343 per year for InDesign, over $975 to buy QuarkXPress – we've got some much cheaper contenders.

The gold standard in this field is, of course, InDesign. QuarkXPress remains an equally strong choice, but it's favoured more by large publishers and corporates than individual designers and studios. That's at least partly because InDesign is part of Adobe's broader Creative Cloud suite, which is unbeatable value if you need several of its apps.

Affinity Publisher, launched by Serif in the summer to complete its own smaller but more tightly integrated graphics suite, is available as a one-off purchase for less than a quarter of the annual price of InDesign alone. It's by far the most credible budget option, but we also tried the even cheaper iStudio Publisher and Swift Publisher as well as comparing page layout in Apple's free Pages.

Desktop publishing is primarily about print, whether to your laser or inkjet or preparing PDF files for commercial printing. InDesign and Pages can also be used to create both reflowable and fixed-layout ebooks; Pages comes with several illustrated ebook templates and can export directly to Apple Books, although Apple also offers iBooks Author, with more interactive features. iStudio Publisher can export a 'text flow' (story) as an EPUB, but it's a poor tool for the job. Any of these apps are also good for casual layouts that you can just share as JPEGs or one-off prints.

Things to consider...

Everything you need to know before getting started.

1 LAYOUT TOOLS
It should be quick and easy to set up the guides you need, then create text and graphics boxes on the page, with features that help you size, position and align everything accurately and consistently.

2 TEXT HANDLING
A DTP app should let you style text using all the features of OpenType fonts, with detailed spacing controls, and flow copy through complex multi-column layouts. Named text styles enable quick and consistent formatting.

3 MASTER PAGES
To design anything other than a simple one-off document, you'll want to set up master pages with guides and regular items. This should be as flexible as possible.

4 OUTPUT
DTP isn't just for desktop printing: magazines like the one you're reading now go to press as PDF files exported from DTP apps. But printing companies are rightly wary of trying to output files without proper prepress controls in place.

5 EXTRAS
Templates are useful to get you started, but only if they're attractive and properly formatted – and customisable. Ready-made graphics and effects may avoid having to use another app, but can be gimmicky.

How we tested

We installed the latest versions of all the apps on the same 15in MacBook Pro with Retina display running macOS Mojave (Catalina was still in beta) and then tried a range of page layout tasks, assessing ease of use, breadth of features and the ability to create professional results.

Higher... QuarkXPress 2019

FROM $975
QUARK.COM
InDesign's newly upgraded top-end rival remains a superbly capable package with a huge ecosystem of support and integration.

...or lower? Publisher Lite

FREE, WITH IN-APP PURCHASES
MAC APP STORE
This simple app is free from the Mac App Store, with template packs for $1.49. Publisher Plus adds features and includes all templates for $30.99, but it's a year since the apps were updated.

Test 1 Page layout

Doc setup, master pages and tools.

All the apps have adequate tools for arranging text and pictures, although iStudio Publisher lacks layers. Like InDesign, Affinity Publisher lets you set up nested master pages, sections, and varying page sizes. Most publications will be designed as spreads ('facing pages'), and iStudio and Swift Publisher now get this, but neither caters well for long or complex documents, and iStudio's fixed master page structure is too rigid.

Pages' Page Layout mode is DTP-like but limited: facing pages are shown side by side, but you can't span items across, and there's no concept of bleed. iStudio Publisher supports bleed (though its own templates ignore it) and has good alignment aids and a snap grid, but is the only app without guides – an absolute essential for serious layout work – or a table editor. InDesign and Affinity help you generate an index and table of contents, Pages only the latter.

TEST RESULTS

Adobe InDesign	★★★★★	Pages	★★★☆☆
Affinity Publisher	★★★★½	Swift Publisher	★★★☆☆
iStudio Publisher	★★☆☆☆		

Test 2 Text handling

Typesetting, columns and flow.

Swift Publisher is the only app that can't create multiple columns within a text box; instead, you draw a box per column and link the text flow, also possible (and often necessary) in the other apps. iStudio Publisher alone offers no column guides or named text styles. Although you can copy and paste formatting, this isn't really good enough. Swift Publisher's named styles apply to selections (like character styles), while Affinity and Pages join the pro apps in offering separate named paragraph and character styles.

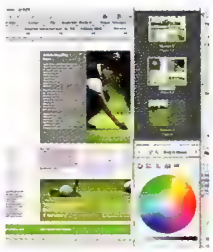
Only InDesign and Affinity have full typographic controls, including the ability to balance character and word spacing. Affinity's optical margin alignment is superior. Swift, like Pages, uses macOS' Fonts panel for styling and OpenType features, but like iStudio lacks advanced spacing. InDesign gives you access to the extensive Adobe Fonts library.

TEST RESULTS

Adobe InDesign	★★★★★	Pages	★★★½☆
Affinity Publisher	★★★★½	Swift Publisher	★★★☆☆
iStudio Publisher	★★☆☆☆		

Test 3 Usability

User interface and getting started.



On startup, all the apps offer help and templates except Affinity, which just has a couple of examples. iStudio's templates, accessed via web browser, are more plentiful for US paper than A4. Across the board, we found the choice and quality of templates pretty random, not least with InDesign's user-submitted stock layouts.

Each app remembers how you arrange its panels, but only InDesign can save and load workspaces. Affinity Publisher aligns both with its sister apps and DTP norms, with many key shortcuts matching InDesign's. Pages feels different, but is easy enough to use. Swift Publisher and iStudio Publisher are more idiosyncratic. iStudio, the only app with no dark mode, feels clunky but makes a lot of tools visible. Swift has fun effects, clip art and photo filters, yet lacks basics like checking image resolution. All the apps performed smoothly, but Swift often maxed out our CPU.

TEST RESULTS

Adobe InDesign	★★★★★	Pages	★★★☆☆
Affinity Publisher	★★★★½	Swift Publisher	★★★☆☆
iStudio Publisher	★★★☆☆		

Test 2 Output

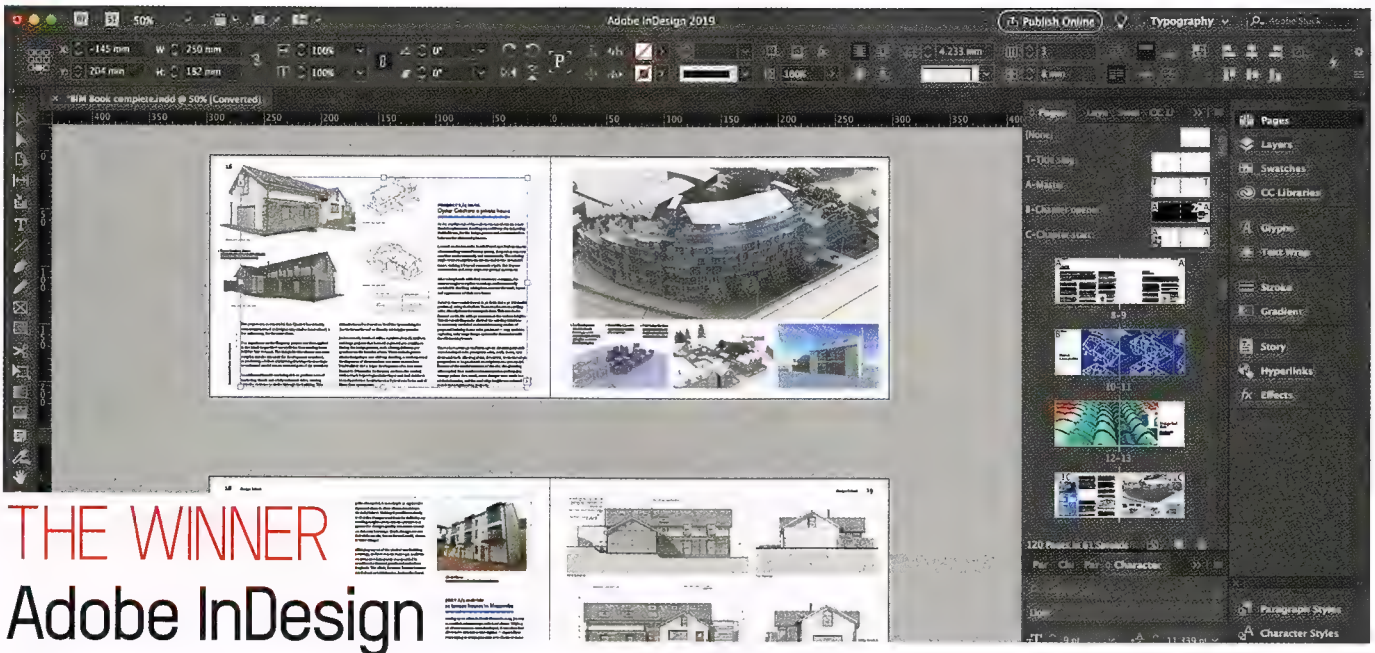
Pro features to take your work further.

DTP software originally envisaged output on a personal laser printer, but soon became focused on commercial printing, for which preparation is technically more demanding. It's hard to compete here with the industry credibility of InDesign, but Affinity Photo has adequate colour management and PDF options. The other apps have basic PDF output, suitable for on-screen reading but risking unforeseen issues on press.

All can print to a laser or inkjet printer, but if you want to output A5 spreads on A4 paper, or A4 on A3, arranged to fold and staple into a booklet – known as 'imposition' – only Swift Publisher can print like this directly; it also has some useful PDF options. iStudio Publisher can export an imposed booklet as a PDF, but printing this would be no simpler than opening any PDF in Adobe Reader and using its booklet printing options.

TEST RESULTS

Adobe InDesign	★★★★★	Pages	★★☆☆☆
Affinity Publisher	★★★★½	Swift Publisher	★★★½☆
iStudio Publisher	★★☆☆☆		



THE WINNER

Adobe InDesign

Fast, flexible, powerful DTP.

Except for QuarkXPress, there's still no equal to the depth and industry support of Adobe InDesign. But Affinity Publisher is an affordable alternative that's surprisingly complete.

That's not to rule out its budget competitors. iStudio Publisher has a fresh and friendly approach, but we can't overlook that some of the features on its 'Future Developments' list should have been foundational, including guides, styles, and easier image cropping. Anyone using Word or PowerPoint for casual home and school documents should give Swift Publisher a try. While iStudio has a 30-day trial, Swift is unlimited except for watermarked output, and a licence is significantly cheaper than Affinity. But it's not a contender for commercial work.

Apple's Pages is a versatile free app for tasks from word processing to posters, but the lack of depth means it's easy to grow out of. It needs proper facing pages, better type control and some prepress chops to qualify in DTP.

How do they compare?

SPECS	ADOBE INDESIGN 14	AFFINITY PUBLISHER 1.7	ISTUDIO PUBLISHER 1.4	PAGES 8.1	SWIFT PUBLISHER 5.5
PRICE	$29.99/MONTH	$79.45	US$17.99	FREE	US$19.99
WEBSITE	ADOBE.COM/AU	AFFINITY.SERIF.COM	ISTUDIOPUBLISHER.COM	APPLE.COM/AU	SWIFTPUBLISHER.COM
SPREAD EDITING	YES	YES	YES	NO	YES
GUIDES	YES	YES	NO	YES	YES
LAYERS	YES	YES	NO	YES	YES
IMAGE EDITING	NO	YES	NO	YES	YES
SAVE WORKSPACE	YES	NO	NO	NO	NO
PREPRESS	YES	YES	NO	NO	NO
SPOT COLOURS	YES	YES	NO	NO	NO
FIXED-LAYOUT EPUB	YES	NO	NO	YES	NO
TEMPLATES INCLUDED	YES	NO	YES	YES	YES
OTHER PLATFORMS	WINDOWS	WINDOWS, IPAD DUE 2020	NO	NO	NO
TEST 1: PAGE LAYOUT	★★★★★	★★★★½	★★½☆☆	★★½☆☆	★★½☆☆
TEST 2: TEXT HANDLING	★★★★★	★★★★½	★★½☆☆	★★½☆☆	★★½☆☆
TEST 3: USABILITY	★★★★★	★★★★½	★★½☆☆	★★½☆☆	★★½☆☆
TEST 4: OUTPUT	★★★★★	★★★★½	★★½☆☆	★★½☆☆	★★½☆☆
OVERALL	★★★★★	★★★★½	★★½☆☆	★★½☆☆	★★½☆☆

Note: The final verdict scores reflect the overall opinion of a product and are not necessarily an average of the criteria listed in the table.

PART 01 - PAGE 68

Monitor your drive space

Find how what happens when you run out of free space, and how to keep an eye on how much is left.

Part 02 - page 70

Clean up your PC

Before deciding if you need to invest in more storage, make sure you're not wasting the space you already have.

Part 03 - page 72

Move your files

Take the strain from your hard drive by moving files elsewhere – on to another drive or into the cloud.

Part 04 - page 74

Upgrade your hard drive

Another way to increase storage is to migrate Windows to a separate, faster SSD drive.

FREE UP SOME SPACE

How can you ensure your PC doesn't run out of storage capacity? Nick Peers has some pointers...

"You have run out of disk space". There it is, unequivocal. It wasn't that long ago that Windows started popping up "You are running out of disk space" messages, swiftly followed by "You are running very low on disk space". No matter, the day has finally arrived. Your hard drive has finally run out of space and now you've got to do something about it. The question is: what?

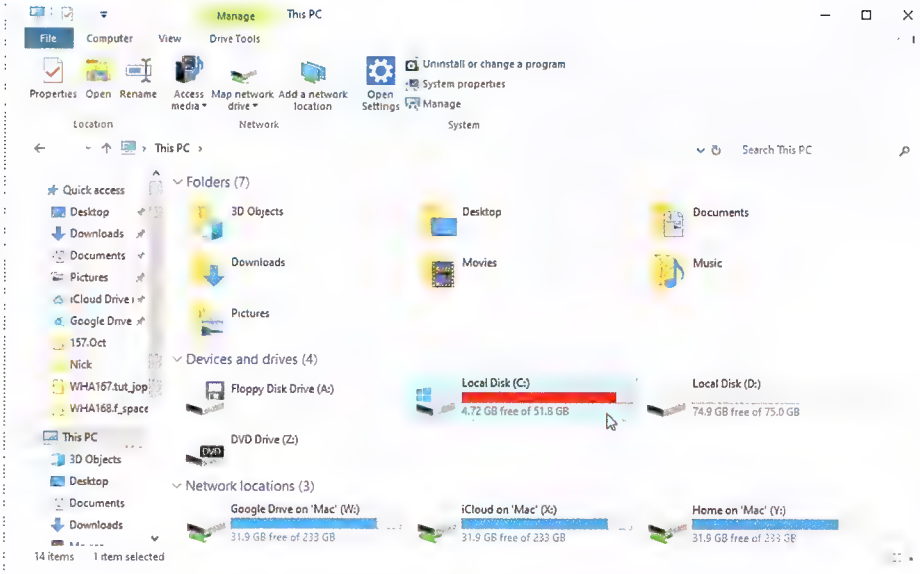
These days, running out of disk space should be impossible. With terabytes of storage available to you, how do you manage to fill it all up? One reason might be that you don't actually have terabytes to start with: perhaps you're running on a laptop that only came with 128GB to start with, or a 2-in-1 tablet whose 32GB is barely enough to fit Windows on, never mind any apps or data.

Don't panic, though, because over the course of the next eight pages we'll show you everything you need to know to solve the problem. You'll learn to spot the early warning signs, plus take steps to keep your hard drive as clean as possible. We'll also examine ways of adding extra storage capacity, enabling you to move your data off your boot drive to free up space. And if all else fails, we'll show you how to upgrade your PC's boot drive, plus migrate everything from old to new drive. It's all here, so turn the page now to solve your disk space issues.

Monitor your drive space

Find how what happens when you run out of free space, and how to keep an eye on how much is left.

That low disk space warning we flagged in the introduction is unlikely to be the first indication you get that you're running out of disk space. It's not designed to appear until you have 200MB or less free disk space – a mere drop in the ocean these days. Instead, Windows' first warning will likely appear when you open File Explorer to the 'This PC' view to see your drive's usage is represented by a red bar rather than the regular blue one. This appears when your drive has less than 10% free space left, although the seriousness of the warning does depend on the size of the drive. For example, a 64GB drive with under 6GB left is more worrying than a 2TB drive with around 180GB free space still available.



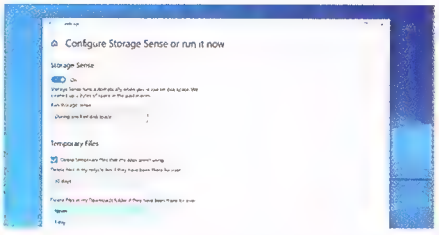
A red bar indicates that less than 10% free space remains on the drive in question.

MORE DRIVE ALERTS

Windows Update will also throw up an alert when it discovers there's insufficient space to install the latest round of updates – this usually appears when you don't have secondary storage attached to your PC for it to use as temporary file storage. It can pop up when there's as much as 11GB still free on your drive for major feature updates, but of more concern is if it shows when you're trying to install a cumulative update, which indicates your drive has less than 3GB left.

All computers make use of small recovery partitions (anywhere from 500MB for a basic Windows recovery partition to 8GB for a partition housing the files needed to reinstall Windows). Sometimes, these recovery partitions can be assigned drive letters in Windows – often in error. Because they're designed to store specific files and not anything else, they can be filled almost to capacity, which results in Windows throwing up a low space disk warning.

The solution is simple: type 'disk'

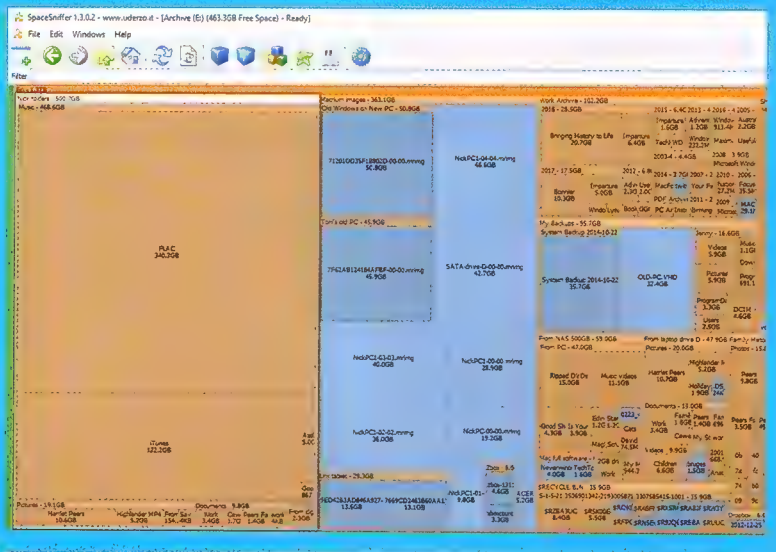


To configure Storage Sense, navigate to Settings > System > Storage and click 'Show more categories'.

An alternative view

If you're looking for a slightly different approach to viewing your drive's makeup, try SpaceSniffer (**www.uderzo.it/main_products/space_sniffer/**) instead. It has a more modern user interface, but more importantly provides a visual view that helps you identify which folders contain the most files. Again, be sure to run it as an administrator. Unlike WinDirStat you must focus a view on one drive at a time, but thanks to its labelling system it's easier to spot which folders contain the most data as they're clearly named, and their file size listed. Simply double-click one to zoom in to view its contents or double-click its parent folder (displayed above it) to zoom back out.

If you know which files are likely to take up most space on your drive, use the Filter box to input a file type (such as *.mp4) and click the Filter button to focus on that instead. Right-clicking a displayed folder will bring up the File Explorer context menu, allowing you to delete unwanted files quickly if you wish.



Treemapping is a method of displaying hierarchical data, such as the folder structure on a large hard drive, in a logical way, making it easy for a human to understand.

into the Search box and click 'Create and format hard disk partitions' to open Disk Management. Locate your Recovery partition in the list, then right-click it and choose 'Change Drive Letter and Paths'. Click Remove followed by Yes at the warning and finally OK. Bingo, no more warnings for that drive.

MONITOR DISK USAGE

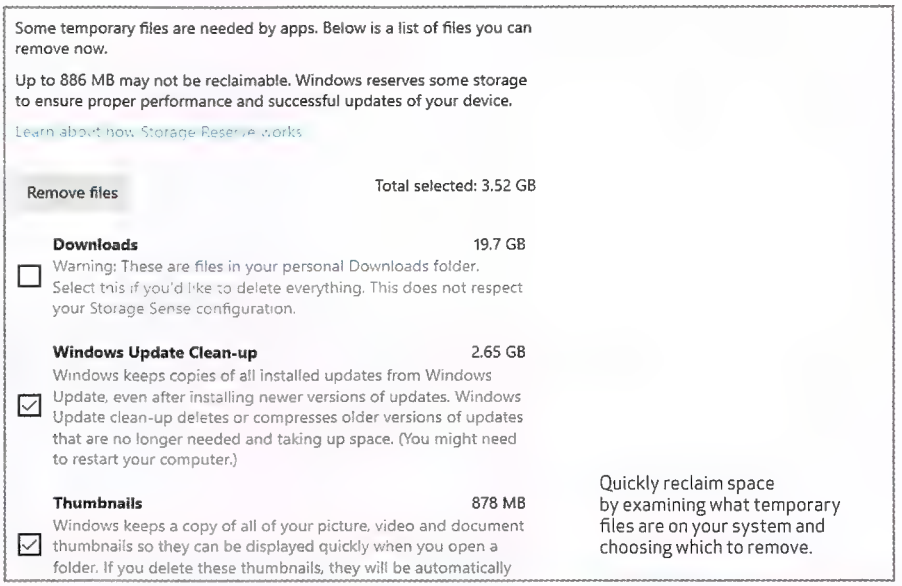
It's all very well knowing that your free space is disappearing, but what's taking up all that room? Your first stop on the quest for knowledge should be Windows' own tools: navigate to Settings > System > Storage and after a short while, Windows will reveal what types of file are taking up the most space on your system drive. You'll see categories for Apps & features and Temporary files, and you can click 'Show more categories' for a more precise listing of usage by categories as varied as Mail, Documents and Videos.

Click an entry in the list and you'll be able to not just view more detail, but take remedial action: for example, if your Temp files are gobbling gigabytes of space, click this to manually clean them up – note, the Temp setting now covers files stored in your Downloads folder, although they are excluded by default. As you'll see over the page, you should make use of Windows' new Storage Sense feature to manage this automatically, removing temporary files as required to prevent your PC from running low on disk space.

Although Windows provides an 'Other' view to cover large folders, it's not capable of easily highlighting those individual files and folders that are taking up the most space on your hard drive. To search for these requires a third-party tree-mapping tool. Tree-mapping tools provide a visual representation of each file on your hard drive(s) in the form of blocks, with the size of each block corresponding to the size of the file in question.

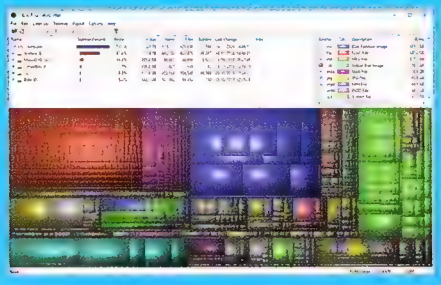
One such free tool is WinDirStat (**https://windirstat.net/**), which you can download and install from its parent website or add to your PortableApps toolkit for running on-demand. To add it to your toolkit, open the PortableApps platform and click 'Apps > Get More Apps > By Category' – you'll find WinDirStat in the Utilities section. Once installed, right-click the program shortcut and choose 'Run as administrator' to allow it to check your entire drive, then check out the step-by-step guide to find out how to use it to both target and – if necessary – delete individual files. Check out the box for an alternative tool should WinDirStat's somewhat garish user interface put you off.

Once you've determined where all your drive space has gone, you can move on to decide how to tackle the problem. Turn the page to find out how.


Some temporary files are needed by apps. Below is a list of files you can remove now.
Up to 886 MB may not be reclaimable. Windows reserves some storage to ensure proper performance and successful updates of your device.
Learn about how Storage Reserve works
Remove files
Total selected: 3.52 GB
Downloads
19.7 GB
Warning: These are files in your personal Downloads folder. Select this if you'd like to delete everything. This does not respect your Storage Sense configuration.
Windows Update Clean-up
2.65 GB
Windows keeps copies of all installed updates from Windows Update, even after installing newer versions of updates. Windows Update clean-up deletes or compresses older versions of updates that are no longer needed and taking up space. (You might need to restart your computer.)
Thumbnails
878 MB
Windows keeps a copy of all of your picture, video and document thumbnails so they can be displayed quickly when you open a folder. If you delete these thumbnails, they will be automatically
Quickly reclaim space by examining what temporary files are on your system and choosing which to remove.

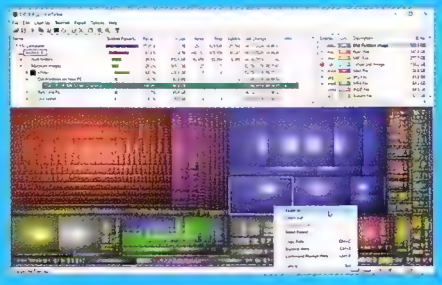
"You should make use of Windows' new Storage Sense feature to remove temporary files automatically to prevent your PC from running low on disk space."

Monitor disk space with WinDirStat



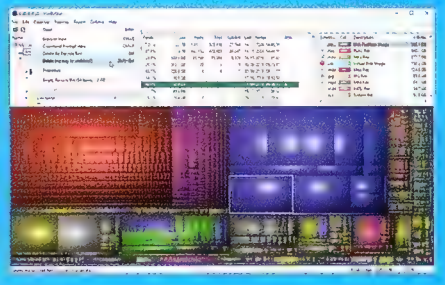
1 VIEW A SUMMARY

You can choose to monitor all drives or focus on a specific drive. Make your choice and click OK. Wait for WinDirStat to finish its analysis and you'll see a three-paned window. The bottom provides a colour-coded 'map' of your hard drive according to how it's being used.



2 INVESTIGATE IN DETAIL

Click an item on the map and its filename and path will be revealed in the top left pane, which shows a traditional folder view. Right-click and choose 'Zoom in' to view a map of the next level down: either a specific drive or the folder containing your target file.



3 REMOVE LARGE FILES

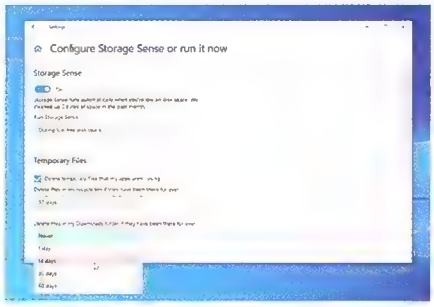
When you've identified a file you think is safe to remove, select it and open the Clean Up menu. You can delete it directly from here or choose 'Explorer Here' to open a File Explorer window pointing to the parent folder, allowing you to examine it more closely.

Clean up your PC

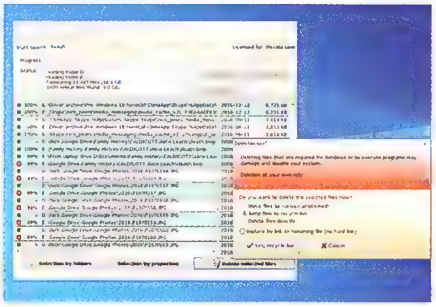
Before deciding if you need to invest in more storage, make sure you're not wasting the space you already have.

Freeing up space on your PC has never been easier thanks to Windows 10's new Storage Sense feature, which is designed to render third-party apps like CCleaner redundant. Your first job, therefore, is to employ its services to free up additional space on your drive. Navigate to Settings > System > Storage and click the 'Configure Storage Sense or run it now' link. Flick the Storage Sense switch on and choose when to run the disk-cleaning tool: by default, it'll run when you run low on disk space, but if you want to take a more pre-emptive approach you can run it monthly, weekly or even daily.

Scroll down to configure more options – for example, removing temporary files, emptying files from the Recycle Bin after a set period and periodically cleaning out the Downloads folder. You can also configure OneDrive's on-demand feature so downloaded content reverts to online-only if unopened for 1, 14, 30 or 60 days. Desperate for more space? Click 'Clean now' to perform a one-time cleanup.



If configured correctly, Storage Sense will do much to tidy up after you and keep drive space free.



Provide yourself with a safety net before you weed out unwanted duplicates in AntiTwin – just in case.

FILES ON-DEMAND

If you're a Microsoft OneDrive user, then chances are you're already taking advantage of a relatively recent feature known as "on-demand". Instead of keeping everything physically stored on your computer, a series of shortcuts are created instead pointing to the online files. These take up a fraction of the space, while ensuring your files are always accessible (so long as you're connected to the internet). Simply open a file in the normal way and it'll be downloaded to your PC, kept there indefinitely or – if configured as outlined above – until the file hasn't been touched for a set period, at which point it'll revert to online-only to free up space on your PC until you next open it.

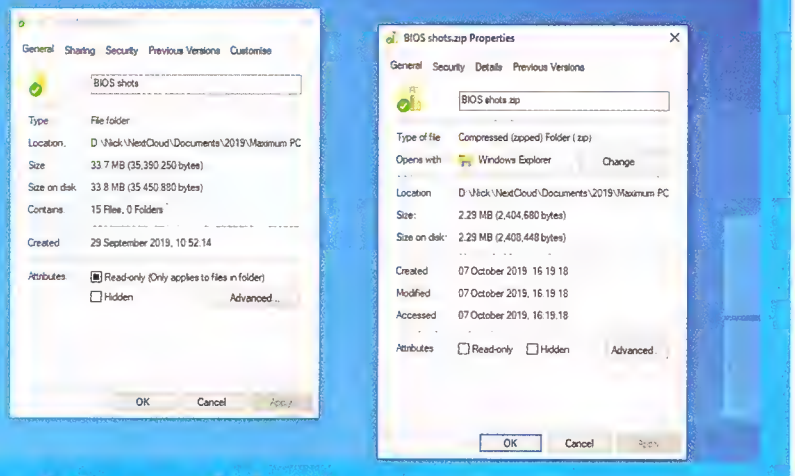
Verify the feature is on by right-clicking the OneDrive icon and choosing Settings > Settings tab, then ensuring 'Save space and download files as you use them' is ticked.

TRACK DOWN DUPLICATES

It's amazing how easily we generate copies of files – or near-duplicates in the case of digital photos, with multiple attempts to get the perfect shot all somehow being left on your drive at the end of the process. In the past we've looked to Duplicate Cleaner Free (**www.digitalvolcano.co.uk/duplicatecleaner.html**) and AntiDupl (**https://ermig1979.github.io/AntiDupl/english/**) to cover these bases for free. The Pro version of Duplicate Cleaner ($50.95) can also hunt out similar files, but before investing why not give AntiTwin (**www.joerg-rosenthal.com/en/antitwin/**) a go?

Despite not having been updated since 2010, this no-frills tool works perfectly in Windows 10 and can cover all your bases as the step-by-step guide reveals. Your selections are clearly marked before you commit to any deleting of files, and when you click to delete you're given the option of moving them to a folder on the same drive for transferring elsewhere, sending them to the Recycle bin or deleting them directly.

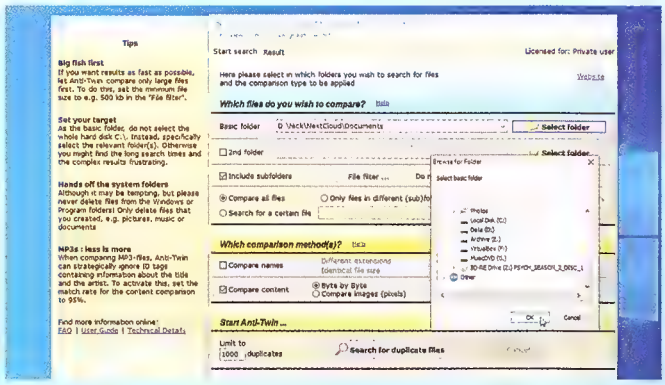
Look too for the option to replace the file with a symbolic link to the file you've kept – this means a program referencing the file you've deleted will be redirected to the remaining file instead, ensuring it continues to work correctly.


General Sharing Security Previous Versions Customise
BIOS shots
Type File folder
Location D:\Nick\NextCloud\Documents\2019\Maximum PC
Size 33.7 MB (35,390,250 bytes)
Size on disk 33.8 MB (35,450,880 bytes)
Contains 15 Files, 0 Folders
Created 29 September 2019, 10:52:14
Attributes Read-only (Only applies to files in folder) Hidden Advanced...
OK Cancel
BIOS shots.zip Properties
General Security Details Previous Versions
BIOS shots.zip
Type of file Compressed (zipped) Folder (.zip)
Opens with Windows Explorer Change
Location D:\Nick\NextCloud\Documents\2019\Maximum PC
Size: 2.29 MB (2,404,680 bytes)
Size on disk: 2.29 MB (2,408,448 bytes)
Created 07 October 2019, 16:19:18
Modified 07 October 2019, 16:19:18
Accessed 07 October 2019, 16:19:18
Attributes Read-only Hidden Advanced...
OK Cancel

Archive old files

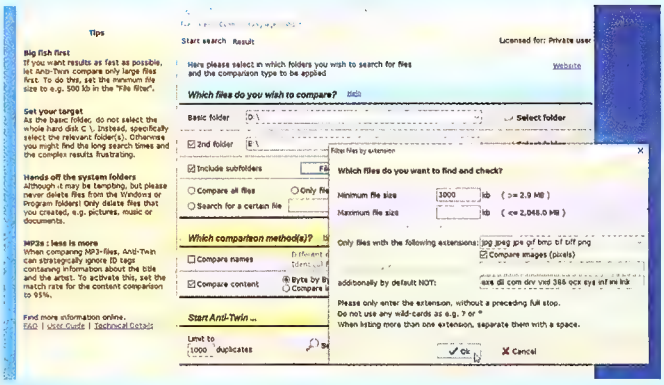
Another way to save space is to move folders and files on to a secondary storage drive, such as a USB drive. If you don't have this luxury, then save space by zipping up these rarely used files and folders instead. Right-click the item(s) in question and choose 'Send to > Compressed (zipped) folder', then wait for it to be combined into a single zip file. Right-click this and choose Properties, then compare its size to the original file. If there's a significant saving, delete the original file or folder, then repeat to keep freeing up more space.

Remove duplicates with AntiTwin



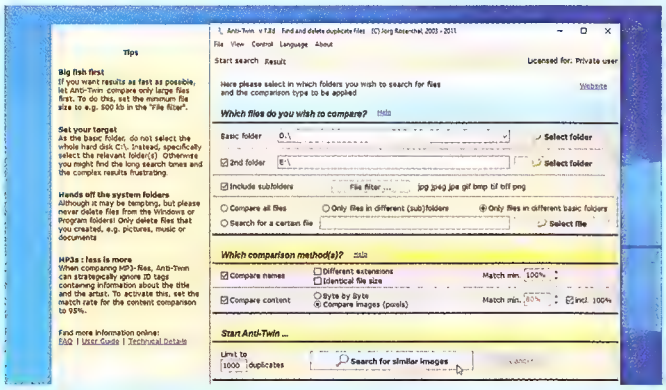
1 SELECT HARD DRIVE

Open AntiTwin. Click 'Select folder' next to 'Basic folder' to select the root of your drive if you're looking to clear up space on one drive only. Tick '2nd folder' to select another folder path or drive if you're looking to clear space across two hard drives by weeding out duplicates.



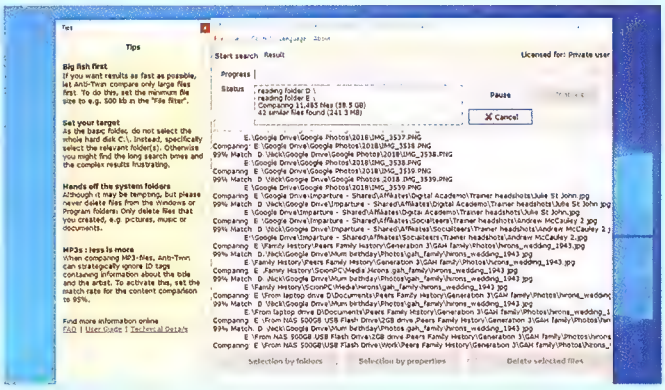
2 FOCUS SEARCH

Leave 'Include subfolders' ticked and click the File filter… button. You can exclude smaller files from the search (and speed it up) by setting a minimum file size. Click the dropdown as shown to focus on specific file types, and tick 'Compare images (pixels)' if you're looking for visually similar images.



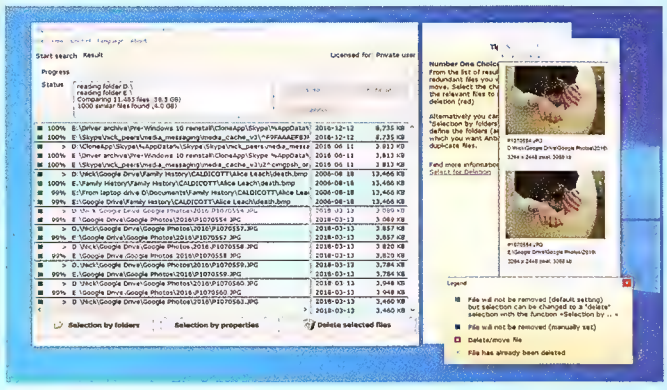
3 PICK YOUR COMPARISON METHOD

By default, files are compared according to their content only, but you can also compare by name and file size if you wish. The 'Match min' figure allows you to match similar, but not identical, files – this is best left for image searches only. Once done, click the Search button



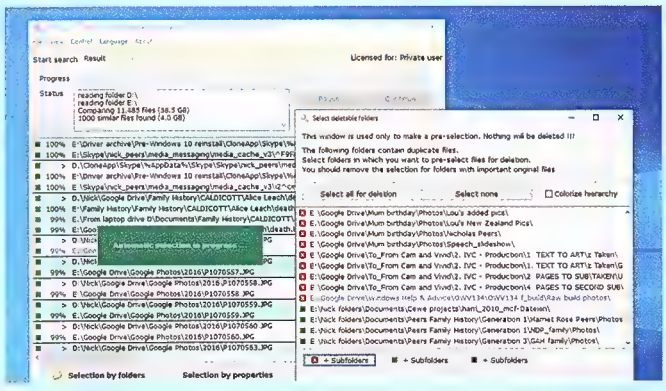
4 WAIT FOR SCAN

A progress window will appear – don't be surprised to see it freeze occasionally as files are checked. You can pause or cancel the search at any time. After the folder contents have been read, files will be compared to see which are duplicates and (if selected) close matches.



5 REVIEW RESULTS

If you chose two paths, read the warning, but click OK as this would only be an issue if they were both pointing to the same folder. A list of all duplicates and similar files will be shown, grouped together. Images can be compared by selecting one to reveal a pop-up window.



6 REMOVE DUPLICATES

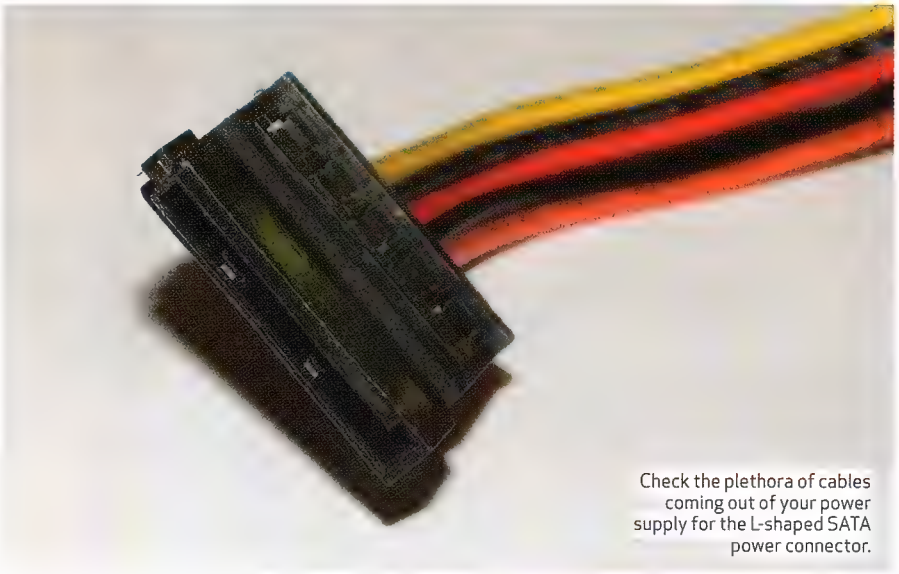
Right-click a file to decide whether to keep or remove it – you'll also see options that allow you to mark specific folders as duplicates (see main text). After making your selections, use the legend to verify you've picked the right files to delete before clicking 'Delete selected files'.

Move your files

Take the strain from your hard drive by moving files elsewhere – on to another drive or into the cloud.

The march of technology inevitably leads to increased demands on your system, particularly if you've discovered a new space-hungry hobby such as gaming or 4K video editing. If you're simply looking to expand available storage for your files, you have two basic options. The first, of course, is to invest in additional storage. Desktop users can investigate whether their PC case has the room for a second internal hard drive – with 4TB drives shipping for under $200, you can solve all but the most demanding needs with a single purchase.

Before splashing out, power down your PC, open the case and verify there's a spare drive bay to fit it in. Also check your power supply has a spare SATA power socket (see photo – if not, Google 'molex to sata power adapter' to find a cheap adapter) and a spare SATA slot on the motherboard. You'll also need a SATA data cable – these can be had for under $1, but make sure it's SATA III (6Gbps) and consider a right-angled connector on one end for hard-to-reach sockets.



Check the plethora of cables coming out of your power supply for the L-shaped SATA power connector.

ALTERNATIVE UPGRADES

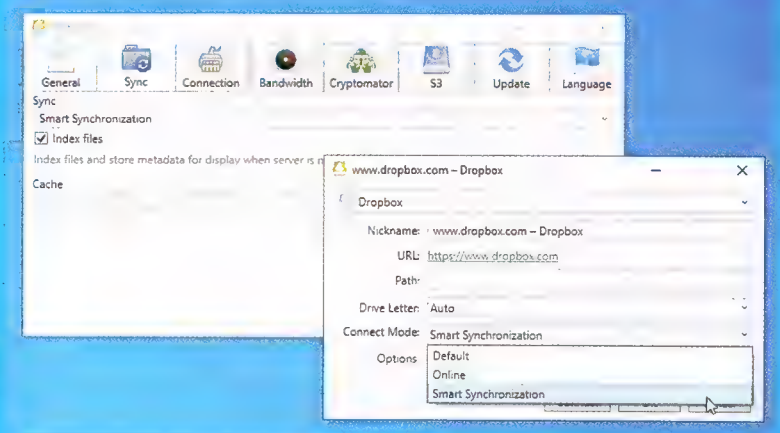
An internal hard drive is better than an external model for reasons of speed, but this isn't always a practical option – for example, if you have a laptop. External drives may be more suited to long-term storage such as backups or archiving, but they can at a pinch be used for day-to-day use, although it's still a good idea to keep frequently accessed files on your internal drive.

If you want to go down the external drive route, then you have two options: USB or NAS. USB prices are incredibly competitive – slightly cheaper, in fact, than internal models – so you can pay a bit over

Into the cloud

Another storage location you can make use of is your cloud provider. We've already seen how you can use OneDrive to free up space on your computer, and other providers offer similar features within their paid-for plans – Dropbox (**www.dropbox.com**) calls its equivalent Smart Sync, for example. Here you need to navigate to a folder inside your Dropbox folder, right-click it and choose 'Smart Sync > Online-only', or browse to 'Preferences > Sync', select your account and choose 'Online-only' to make it the universal default.

If you'd like to access Google Drive or Dropbox folders in this way without a paid account, then for a one-off fee (USD$39) you can use a brilliant tool called Mountain Duck 3 (download a free trial from **https://mountainduck.io/**). This can create a series of virtual drives connecting to a range of online storage services and supports on-demand access like that found in OneDrive across all connected services. Just be sure to set Connect Mode to 'Smart Synchronisation' the first time you connect a new cloud account.



Mountain Duck can mount your cloud storage as virtual drives, with files kept online to save space.

$100 for 4TB or push the boat out and get 6TB for around $200. All models should now be USB 3.0, so for best performance be sure to plug them into a USB 3.0 port (typically marked in blue) on your PC. Expect to pay a small premium for smaller, laptop-friendly 2.5-inch external drives, or consider Network Attached Storage (NAS) instead. These are slower, but use your network connection, so may be a more practical alternative should you not wish to have your laptop permanently connected to a USB drive.

Once your new drive is set up, you'll want to transfer your data across – the step-by-step guide below reveals how to do this for all your user folders, which are where the bulk of your data can be found.

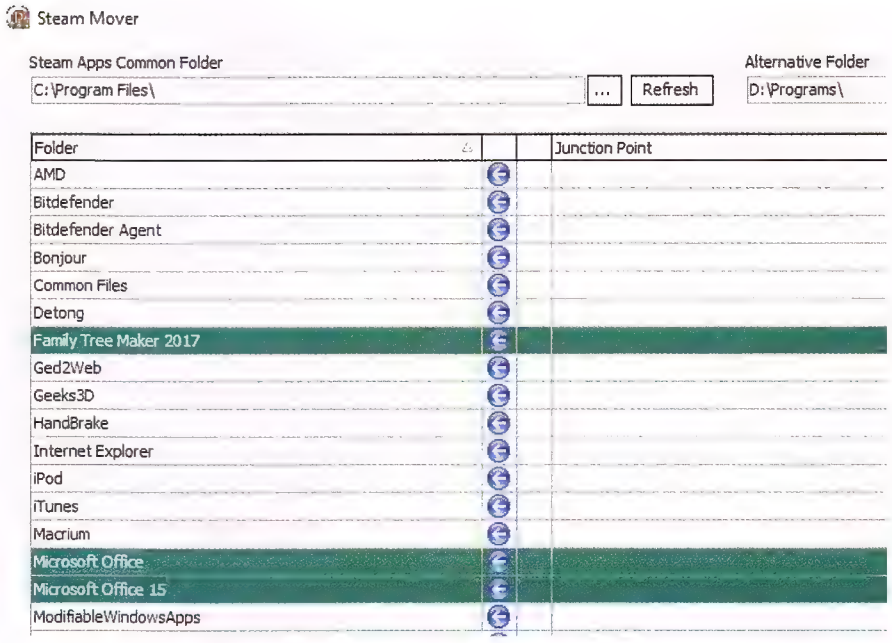
MOVE SOME APPS

If you're running Windows on a very small boot drive – say 32GB – then it's not enough to move data off your system drive, you'll quickly run out of space for new apps too. Where it's not possible to upgrade your system drive for a larger model (see over the page), you can also investigate ways of moving your programs from your system drive to your data one. One caveat: in most cases, your new data drive will be slower than your Windows drive, particularly if you boot from an SSD, so be prepared for a performance hit and try to keep those apps you use most often on your boot drive.

There are two ways to move apps to a new drive: first, Windows Store apps (including those pre-installed with your PC like Photos) can sometimes be moved via 'Settings > Apps > Apps & features'. Click the app in question and look for a Move button – if it's not greyed out, click it, select which drive to move it to and finally click Move again.

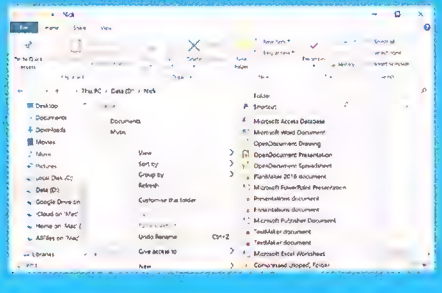
Regular programs are so well integrated into the operating system that you can't simply move their folder from the Program Files folder to your new drive. One option might be to uninstall and reinstall, but that comes at a cost of losing your preferences and assumes the program in question allows you to choose where to reinstall the program too.

A simpler, foolproof option is to use SteamMover (**www.traynier.com/software/steammover**). This clever tool moves your program files to your data drive but leaves a "symbolic link" in its place. This shortcut fools Windows into thinking the programs are still on your C drive, so they continue to work seamlessly. It's easy to use: click '...' under 'Steam Apps Common Folder' and select C:\Program Files, Ctrl-click on the programs you plan to move based on their size and how frequently you use them, then click the right arrow button to move them all across. Changed your mind? Simply select your program and click the left arrow button to move it back, no questions asked. Windows 64-bit users should also check the C:\Program Files(x86) folder for 32-bit apps to move.



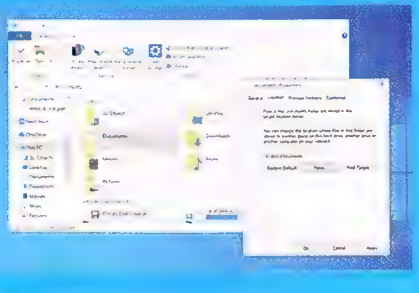
SteamMover allows you to move any program on your PC to another drive without reinstalling it.

Move data to a new drive



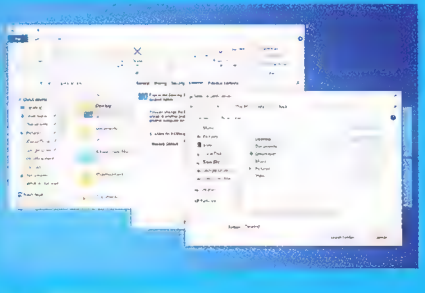
1 SET UP NEW FOLDERS

You can choose to monitor all drives or focus on a specific drive. Make your choice and click OK. Wait for WinDirStat to finish its analysis and you'll see a three-paned window. The bottom provides a colour-coded 'map' of your hard drive according to how it's being used.



2 MOVE USER FOLDERS

Browse back to This PC. Right-click Documents and choose Properties > Location tab. Click Move... to browse to and select the Documents folder you just created. Click 'Select Folder' followed by Apply. When prompted, click Yes to move your files and folders to your new drive.



3 RINSE, REPEAT

Now repeat the process for all the other folders listed – be prepared for a long wait if you have large folders to move across to your new drive. The benefit of this approach is that once complete, you'll have freed up space on your system drive without having to delete anything.

Upgrade your hard drive

Another way to increase storage is to migrate Windows to a separate, faster SSD drive.

Why not turn your problem of storage space – or lack of it – into an opportunity? If you've not done so already, now is the perfect time to investigate one of the most effective upgrades money can buy: a fast solid-state hard drive to run Windows and your programs on. Switching from a clunky old hard drive to a SSD is like leaving the Stone Age. Windows loads in under a minute, apps open in a matter of seconds and your computing life is no longer held up by clicking and waiting for files to load.

With SSD prices tumbling to put even relatively large amounts of storage space in your hands for a modest sum, there's never been a better time to make the move. The upside? Your old drive can stay in use as a dedicated drive for data, with tens – if not hundreds – of gigabytes of space freed up by moving Windows and your programs to the new drive.

It's a three-step process: first, work out what your PC can accommodate and pick the appropriate drive for the task. Once done, investigate the practicalities of fitting it to your PC, and then finally follow a method for migrating everything (or the key elements) of your old drive to the new one.

CHOOSING THE RIGHT DRIVE

If you're a laptop user, you're basically looking for a larger single drive to accommodate Windows, applications and a decent amount of personal data.

2.5-inch drive enclosures are relatively cheap, certainly plentiful, and easy to slot your drive into.

This may involve moving from a relatively small SSD drive (say 128GB or less) or migrating from a large (say 1TB or larger), but cumbersome drive. As always, while it's tempting to save money in the short term, try to stretch your budget to futureproof your purchase for as long as possible. With 500GB SSD drives weighing in at under $100, this should really be your minimum spec. Increase your budget to $200 and you'll find several 1TB SSD drives falling within your grasp too. You'll then need to invest in a USB or NAS drive for those files you access less frequently.

If you're looking to upgrade a desktop PC, then check to see if your case can accommodate a second drive in addition to your current one. Chances are it can, giving you get the best of both worlds: a new SSD drive that can be smaller (say 256GB, or 500GB for those with a gaming habit or the need to run virtual machines), plus your old drive now exclusively used for data storage.

Watch Windows 10 (and startup apps) load in under 30 seconds with NVME storage like this Samsung.

If you have a modern PC with support for the M2 NVMe interface (a small slot on the board into which SSD drives shaped like RAM sticks are plugged), then pay the small premium for this type of SSD storage as it's up to six times faster than SSD, never mind regular hard drives. Samsung's 970 EVO Plus is currently the best – 256GB will set you back around $110, and 500GB around $150.

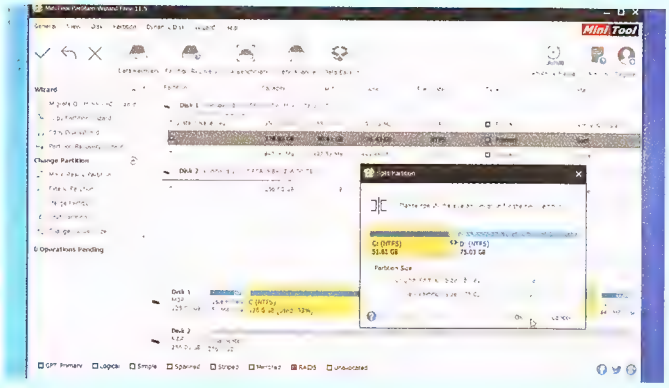
FITTING THE DRIVE

The step-by-step guide opposite reveals how to clone your drive using Macrium Reflect Free. There's one major caveat here: both old and new drives need to be connected to your PC at the same time. For desktop users, this means screwing in your new drive to an available 2.5-inch or 3.5-inch bay if connected via SATA, or carefully slotted into the NVMe slot before being pushed down and held horizontally in place using the screw supplied.

Laptop users have a choice: if you plan to keep the old drive as additional storage, invest $10-15 in a cheap USB 3.0 2.5-inch enclosure and fit the new drive in there. If not, purchase a USB-to-SATA adapter from eBay for as little as $3 online and use that to temporarily connect your new drive to a spare USB port. Once the old drive has been cloned to the new one, swap the two around and your laptop should boot with all settings and data intact

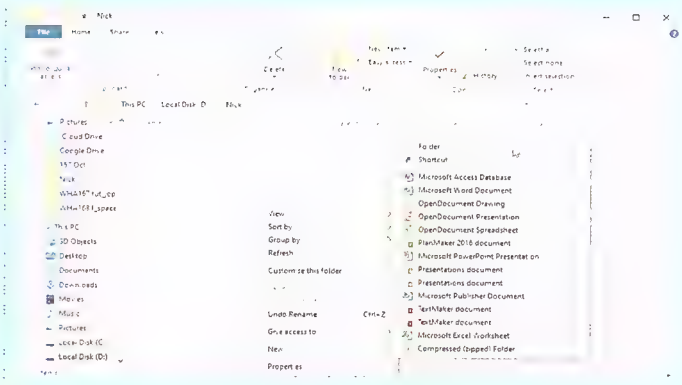
This $10 adapter makes it easy to attach any bare drive to your PC or laptop's USB port.

Migrate to a new drive



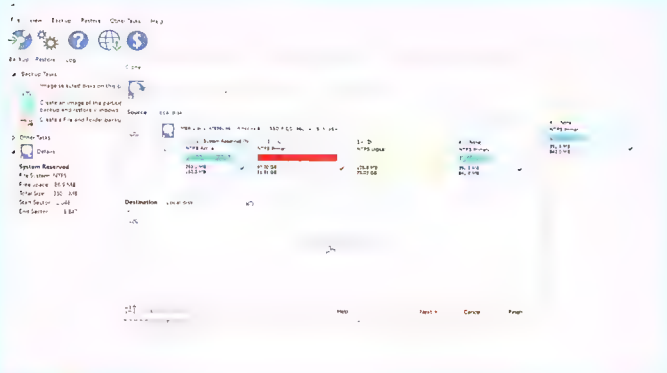
1 PARTITION OLD DRIVE

Desktop users planning to migrate Windows and apps to a SSD drive while leaving their data behind should first use MiniTool Partition Wizard Free (**www.partitionwizard.com**): choose 'Split Partition' and drag the slider as far left as it can go. Click OK followed by Apply. Reboot when prompted.



2 MOVE DATA TO NEW PARTITION

Once complete, follow the guide on the previous spread on moving data to your new drive, using your newly created partition as the target. Next, download and install Macrium Reflect Free from **www.macrium.com/reflectfree.aspx** if you've not already done so.

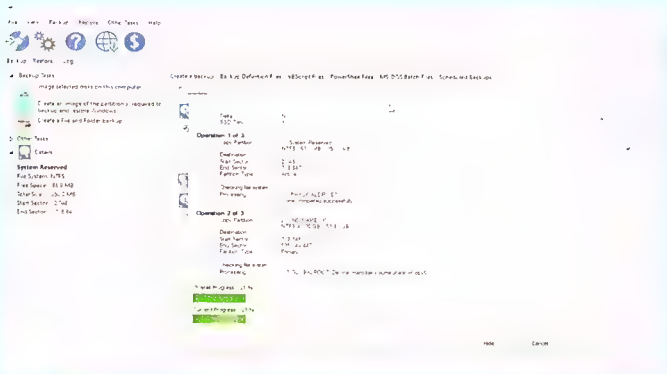


3 SELECT PARTITIONS TO CLONE

Launch Macrium. Select your Windows drive and click 'Clone this disk…' Make sure only those partitions you need will be copied across: System Reserved, your actual Windows partition and any hidden partitions at the end of the drive. Untick any others, then click 'Select a disk to clone to…

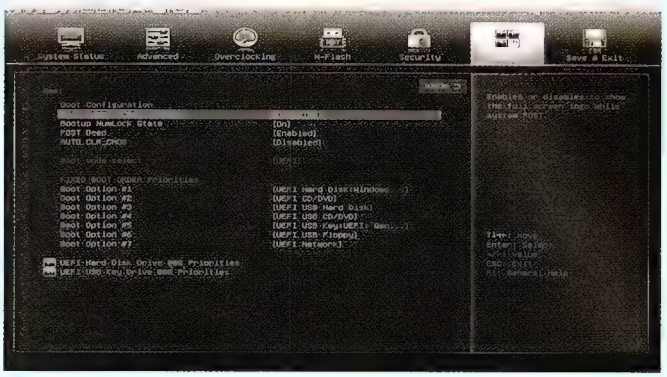
4 SET TARGET DISK

Select your new SSD drive – the one with no partitions assigned. Drag each partition across – you will need to click 'Cloned Partition Properties' to resize your main partition after dragging it across. Set 'Free Space' to match (in MB) the last partition's size, click OK and drag the final partition into place.



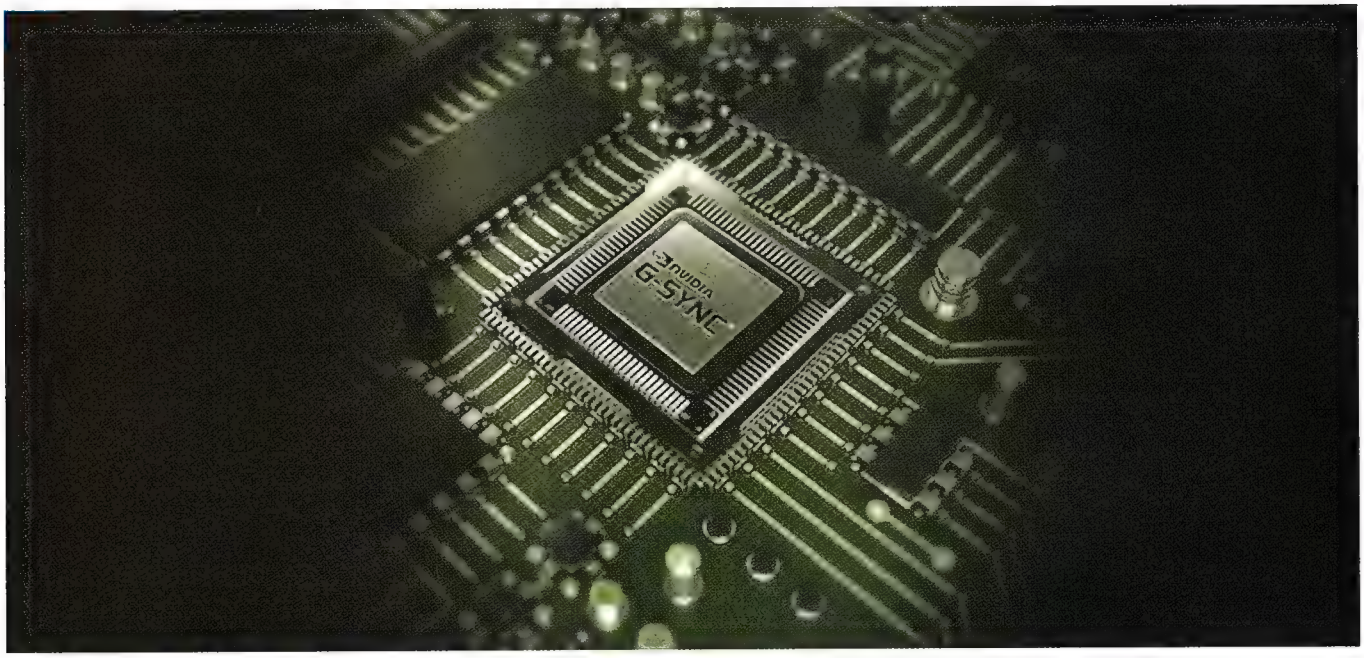
5 WAIT AS DRIVE IS CLONED

Click Finish. Untick 'Save backup and schedules as an XML Backup Definition File' and click OK to perform the cloning operation. Each partition is copied in turn, a quick file check is performed and then the actual cloning process will take place. Be patient – this may take some time.



6 FIT NEW SSD DRIVE

Shut down your PC. Laptop users should swap out the current hard drive for their new SSD drive; desktop users will need to reboot and make sure the new SSD drive is the primary boot device in the UEFI/BIOS settings. If all is well, Windows should boot – and much quicker than before.



System News

The VRR standards war is over, and Mark Williams is relieved.

For almost five years now, the variable refresh rate (VRR) wars have been waged. G-Sync versus FreeSync. Nvidia versus AMD (and the rest of the industry). Open standard versus closed proprietary.

The initial four years of VRR technology had Nvidia's G-Sync technology pitted against VESA's open standard Adaptive-Sync, which AMD branded 'FreeSync'. The result was a whole bunch of vendor lock-in and confusion for early adopters, as both technologies did the same thing and used the same connectors, but were completely incompatible with each other.

G-Sync technology is certainly superior – or at least more stringent – in terms of monitor panel performance metrics required before a G-Sync sticker can be officially bestowed. Not only this, but G-Sync does do some extra processing, giving it features that the more passive Adaptive-Sync/FreeSync simply cannot. The first and most important difference is that G-Sync supports refresh rates all the way down to zero fps, which, when your system is struggling to pump out frames, makes VRR all the more important to image motion smoothness by displaying each frame as soon as it becomes available, and also employing Low Framerate Compensation (LFC) when appropriate to keep the sense of motion smooth by displaying a frame twice.

Adaptive-Sync/FreeSync monitors, on the other hand, have a far less stringent certification process, making for a bit of a wild west when it comes to frame rate ranges that are supported by each monitor. Most of the cheaper ones have quite a narrow range, from about 50Hz up to only 75Hz whereas better ones can be from 30Hz up to 240Hz. The newer FreeSync 2 standard removed the low-end refresh limits and added wider colour gamuts and luminosity to better support HDR. FreeSync 2 has brought the specification closer to G-Sync's capabilities but doesn't quite match it for that out of the box experience. Something G-Sync owners must pay the privilege for, as all G-Sync monitors require extra scalar module hardware, adding a significant premium to the price.

With VESA's Adaptive-Sync being good enough in most situations, though, and Intel declaring that it'll support Adaptive-Sync/FreeSync on its products, and the sheer price difference between otherwise similar G-Sync and FreeSync monitors ($200 to $300 extra), Nvidia was always going to be standing by itself against the rest of the tech industry's momentum. Nvidia may have been first to market with VRR, but it made the mistake of not making it compatible enough or open licensed enough to sustain the initial momentum.

At CES 2019 Nvidia announced that it'll start supporting FreeSync monitors on its graphics cards through a G-Sync Compatible certification program, and manually in the drivers for non-certified monitors, opening GeForce owners up to a wider VRR monitor market. This was the first sign that Nvidia was cracking under the pressure of its lack of standards compatibility, and just 11 months later in November, Nvidia announced that it'll be baking in support for Adaptive-Sync/FreeSync into its very own G-Sync scalar modules so that any G-Sync monitor can also support VRR on any other GPU, console or device without the requirement of an Nvidia GPU. Nvidia has admitted defeat.

Unfortunately, this support will only be available on new monitors manufactured after that date and marked on the box as such as only new G-Sync scalar modules will get support. Older G-Sync monitors won't get any firmware updates.

Everyone is a winner now with VRR equipment. All GPUs will work with any VRR monitor no matter which standard they natively support, and it also allows Nvidia to nurture and improve its G-Sync ecosystem, adding features or support separately to Adaptive-Sync/FreeSync allowing Nvidia to keep pushing it as the premium VRR option, but consumers will no longer be left deciding to go with and being stuck with any one particular GPU maker after they've bought a VRR monitor, which should do wonders for VRR market penetration and uptake. VRR for everyone!

Market Snapshot

A sampling of PC systems available this month.

PLE Adrenaline

$1,749 – TINYURL.COM/APC477PLE

Keeping it simple to win. This system isn't the most expensive in this issue, however, it will easily dominate any gaming performance metrics thanks to its RX 5700, which puts it up into RTX class performance territory – well above the GTX cards of the other systems this issue.

To cater for this more expensive but worthwhile card, PLE has taken a sensible approach to cutting corners in other places. The non-X Ryzen 5 3600 is still a perfect pairing, the motherboard is a little barebones but enough to cover the basics. Memory capacity is great but at 2666MHz is a tad slow for Ryzen's megahertz-loving memory controller.

As an out of the box experience, PLE has done well to maximise gaming performance with only minor hits in other areas. Well done PLE.

KEY SPECS: CPU: AMD Ryzen 5 3600, **COOLER:** OEM, **MOTHERBOARD:** Gigabyte B450M-S2H, **GRAPHICS:** HIS Radeon RX 5700, **MEMORY:** Geil 16GB 2666MHz, **STORAGE:** Kingston 240GB NVMe SSD, WD 2TB HDD, **POWER SUPPLY:** Corsair 650W, **CASE:** Thermaltake H100.

Scorptec Phantom GTX 1660 Ti

$1,699 – TINYURL.COM/APC477SCO

This is the system one would expect to see at this price point without any thought or attempt at differentiation being made to the system. It all feels rather normal. The factory overclocked Ti variant of the GTX 1660 should be noted, the highest of Nvidia's entry-level GPU lineup making it solid for most 1080p situations at higher details. A solid CPU pairing coupled with a reasonable motherboard is good too but not outstanding.

The 500GB SSD plus 2TB HDD storage solution is the largest of the systems and should be commended. A well-rounded build and a solid choice for any gamer.

KEY SPECS: CPU: AMD Ryzen 5 3600, **COOLER:** OEM, **MOTHERBOARD:** Asus TUF B450M-PLUS, **GRAPHICS:** Asus TUF GeForce GTX 1660 Ti OC 6GB, **MEMORY:** Corsair Vengeance LPX 16GB 3000MHz DDR4, **STORAGE:** Western Digital Blue SN500 500GB M.2 SSD, Seagate BarraCuda 2TB HDD, **POWER SUPPLY:** SilverStone Essential 550W, **CASE:** Antec Dark Phantom DP301M Black mATX.

JW Computers GMR Matrexx 1660 Super

$1,799 – TINYURL.COM/APC477JWC

As the most expensive system in this issue, one would expect to have something to show for it. In many respects this does. Most of the extra costs for this build relative to the others were sunk into the Ryzen 5 3600X (note the X suffix denoting higher stock speed) and a quite fancier and dearer motherboard. Unfortunately, the GPU is 'only' a Super Edition GTX 1660, not the highest end Ti variant, but the newer Super version is less than 5% off in performance generally anyway so that's ok given all the other benefits.

The lack of a HDD is something to note, however there is a sizeable 512GB SSD included to compensate. If initial storage capacity isn't a problem for you, this would be a great system to upgrade over time thanks to that higher-grade motherboard.

KEY SPECS: CPU: AMD Ryzen 5 3600X, **COOLER:** OEM, **MOTHERBOARD:** Asus ROG B450-F, **GRAPHICS:** Gigabyte GTX 1660 Super 6GB, **MEMORY:** Adata D60G 16GB 3200MHz, **STORAGE:** Intel 660P 512GB M.2 NVME SSD, **POWER SUPPLY:** CoolerMaster MWE 650W, **CASE:** Deepcool Matrexx 55 Mid-Tower Black RGB.

PC Case Gear Hellfire 1660 Ti

$1,649 – TINYURL.COM/APC477PCC

This is a decent system for the price. Being the cheapest of the bunch it manages to hold up against all the others in terms of GPU, memory, and storage, however the PSU is the lowest wattage of the bunch at just 500W. It's a good quality 500W unit and will certainly be enough for this build, but may hamper future upgrade attempts. The biggest negative against this system is the CPU. At just 12-months old it's not all that old really but AMD's new line-up and Intel's lack of a 10th gen desktop refresh is making this look extremely long in the tooth with not great clock speeds and lack of hyper-threading. It'll be fine and do the job, but you might find yourself being CPU-limited with this system in tasks/games sooner than other offerings currently. Best avoid.

KEY SPECS: CPU: Intel Core i5 9400F, **COOLER:** OEM, **MOTHERBOARD:** MSI B360M Bazooka, **GRAPHICS:** MSI GeForce GTX 1660 Ti Gaming X 6GB, **MEMORY:** Team T-Force Delta RGB 3200MHz 16GB (2x8GB) DDR4 Black, **STORAGE:** ADATA XPG SX8200 Pro M.2 NVMe SSD 256GB, Seagate Barracuda 2TB HDD, **POWER SUPPLY:** Be quiet! Pure Power 11 500W, **CASE:** Phanteks Eclipse P300 Tempered Glass Black.

PC blueprints

The *APC* team's picks for a part-by-part perfect PC build to suit your budget.

PARTS LIST

PART		PRICE
CASE	BITFENIX NOVA TG	$95
PSU	CORSAIR CX450 80+ WHITE 450W	$75
M/BOARD	MSI B450M PRO-M2 V2 **NEW**	$95
CPU	AMD RYZEN 5 2600	$199
GPU	ASUS GEFORCE GTX 1660 SUPER 6GB **NEW**	$389
RAM	8GB (2X 4GB) PATRIOT VIPER @ 3,000MHZ	$65
SSD	120GB ADATA SU650 SATA III **NEW**	$30
HDD	1TB WD BLUE	$59
OS	UBUNTU DESKTOP LINUX 18.04.3 LTS 64-BIT	$0
APPROXIMATE PRICE:		$1,007

Unfortunately, the price of our Budget build has risen a little this issue. The BitFenix case rose and the trusty Asrock B450M motherboard we've used for ages has finally dropped off sale, so we're swapping it out for an MSI B450M motherboard for the same price. We also swapped the Cruicial SSD for an Adata SATA drive. The SU650 isn't particularly exciting, but neither was the part it replaced; it's a SATA drive, it's cheap, and it's effective. We looked into improving the processor, too, but the Ryzen 5 2600 is still an excellent deal.

PARTS LIST

PART		PRICE
CASE	FRACTAL DESIGN MESHIFY C	$149
PSU	500W COOLER MASTER MSW SILENCIO 80+ BRONZE	$55
M/BOARD	ASROCK X570 PHANTOM GAMING 4 **NEW**	$249
CPU	AMD RYZEN 5 3600X	$385
COOLER	AMD WRAITH SPIRE	N/A
GPU	XFX RADEON RX 5700 DOUBLE EDITION 8GB **NEW**	$629
RAM	16GB (2X 8GB) CG.SKILL RIPJAWS V @ 3,200MHZ	$119
SSD	500GB CORSAIR MP600 GEN4 NVME SSD **NEW**	$219
HDD	1TB WD BLUE	$59
OS	WINDOWS 10 HOME 64-BIT OEM	$140
APPROXIMATE PRICE:		$2,004

We've have managed to save almost $100 on this build, and then spent almost all of it on a very exciting upgrade. A few minor changes were made in the name of keeping the price down. We've also swapped to an XFX model of the Radeon RX 5700 GPU, which represents most of our savings, along with a new motherboard – moving away from Gigabyte, we're now using an Asrock X570 Phantom Gaming 4. We needed to keep that X570 format, because the big and exciting change here is a shift over to a shiny new PCIe 4.0 M.2 drive, the MP600 500GB from Corsair, taking advantage of the Ryzen 5 3600X's fourth-generation NVMe support for super-fast data transfers. All up not bad at all for an overall $14 increase over last month.

UPGRADE OF THE MONTH

500GB Seagate FireCuda 520 M.2 PCIe SSD

$TBA, HTTP://SEAGATE.COM

Slowly but surely, more and more manufacturers are putting out PCIe 4.0 M.2 drives. First came Corsair and Gigabyte, swiftly followed by Patriot, Team Group, and XPG. The latest, though, comes from drive production giant Seagate Technology, in the form of the gaming-oriented FireCuda 520 SSD. While on the cusp of release here in Australia, the 500GB model is, at the time of writing, is one of the cheapest PCIe 4.0 drives currently on the market overseas, so if you want crazy transfer speeds without having to spend a ridiculous amount of money, this is expected to be the way to go.

> "We'd love to change some more things, but there's plenty of stuff coming in the near future that will be exciting to see, primarily for this high-end build."

We've decided to wear a bump in the price, this month, but it was worth it. A switch to Gigabyte's Turbo Edition RTX 2080 Super is a big jump over the 2070 Super we ran previously. A particularly pleasing change for this build was the RAM; we stuck with G.Skill, but moved over from Sniper X to the Ripjaws V series, which cost us $20 less, and also has a lower CAS latency for improved performance. It's nice when things work out, isn't it?

We then decided to get ahead of ourselves in a different area. While the Threadripper 2950X doesn't support PCIe 4.0 for speedy new M.2 drives, the next generation of Threadripper does, so we're going to prep our Turbo build with Adata XPG's Gammix S50 1TB, a fourth-gen NVMe SSD that'll be ready to unleash hell with ultra-fast transfer speeds when a Threadripper 3000 CPU is inevitably shoved into this build.

We'd love to change some more things, but there's plenty of stuff coming in the near future that will be exciting to see, primarily for this high-end build. We contemplated going down to a 240mm radiator AIO cooler, but if we're going to be using upgraded parts in the near future, we'll stick with the powerful and good-value ML360 from Cooler Master, for that crisp triple-fan cooling setup. ■

PARTS LIST

PART		PRICE
CASE	NZXT H700I	$219
PSU	850W CORSAIR RM850 80+ GOLD	$179
MOBO	ASROCK X399 PHANTOM GAMING 6	$419
CPU	AMD THREADRIPPER 2950X	$1,179
COOLER	COOLER MASTER MASTERLIQUID ML360 RGB 360MM AIO **NEW**	$179
GPU	GIGABYTE GEFORCE RTX 2080 SUPER 8GB TURBO EDITION **NEW**	$1,199
RAM	32GB (2X 16GB) G.SKILL RIPJAWS V SERIES @ 3,600MHZ **NEW**	$219
SSD	1TB ADATA XPG GAMMIX S50 M.2 NVME **NEW**	$419
HDD	2X 3TB SEAGATE BARRACUDA COMPUTE	$360
OS	WINDOWS 10 HOME 64-BIT OEM	$140
APPROXIMATE PRICE:		$4,512

how to

» QUICK TIPS

Experts solve your computing problems

APC and its readers can be one giant helpdesk. If you have a technical problem, chances are one of us can solve it.

WINDOWS

STOP SHARING A WINDOWS ACCOUNT

My wife and I share a Google account, email and so on, but I use Windows 10 on a PC in my study and she uses the same on a laptop in the lounge. She has recently upgraded to a new laptop which I set up for her, but whereas her previous laptop had her name on the welcome screen, it now has mine, as it appears on my own PC welcome screen. Is there any way we can change the welcome screen name on my wife's laptop?
Martin Gulliver

This occurs because you're sharing the same Microsoft Account to log into both PCs. The logical step is to set your wife up with her own Microsoft Account. If you go down this route, start by copying everything inside C:\Users\martin into the C:\Users\Public folder, then use CloneApp (**www.mirinsoft.com/ms-apps/cloneapp**) to back up any program settings you can't easily recreate in the new user account. Once done, create the new account via 'Settings > Accounts > Family & other users' (click 'Add a family member', choose 'Add an adult' and then click 'The person who I want to add doesn't have an email address' before following the prompts to create the account, making sure they have administrator access).

Once done, log off the Martin account, then log on as your wife. Navigate to C:\users\Public to copy the folders to your new user account. Verify all her existing programs are present – some may need reinstalling if they were installed for a single user rather than all users – and then finally run CloneApp to restore her preferences.

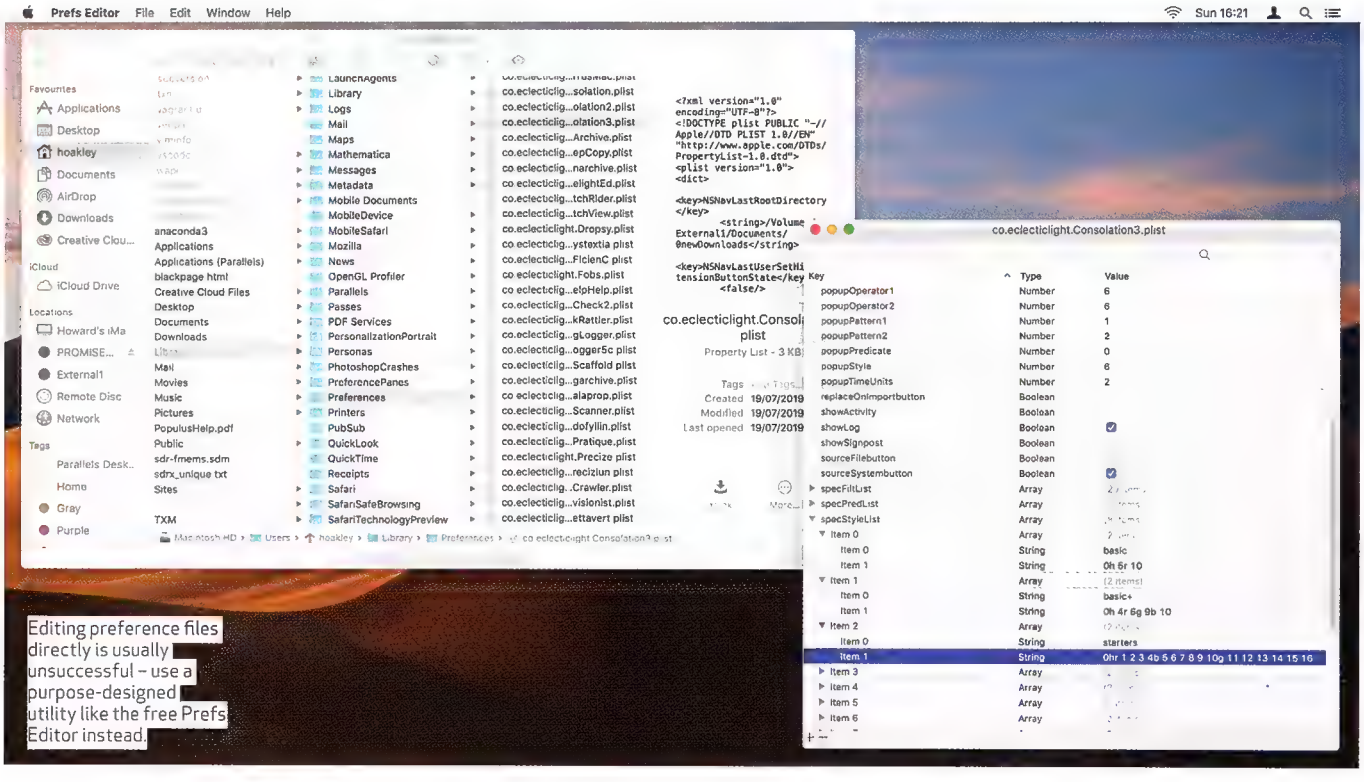
Once you're happy everything has been transferred across, clean things up by emptying the Public folder and then deleting the old user account via 'Settings > Accounts > Family & other users.
Ian Sleightholm

MAC

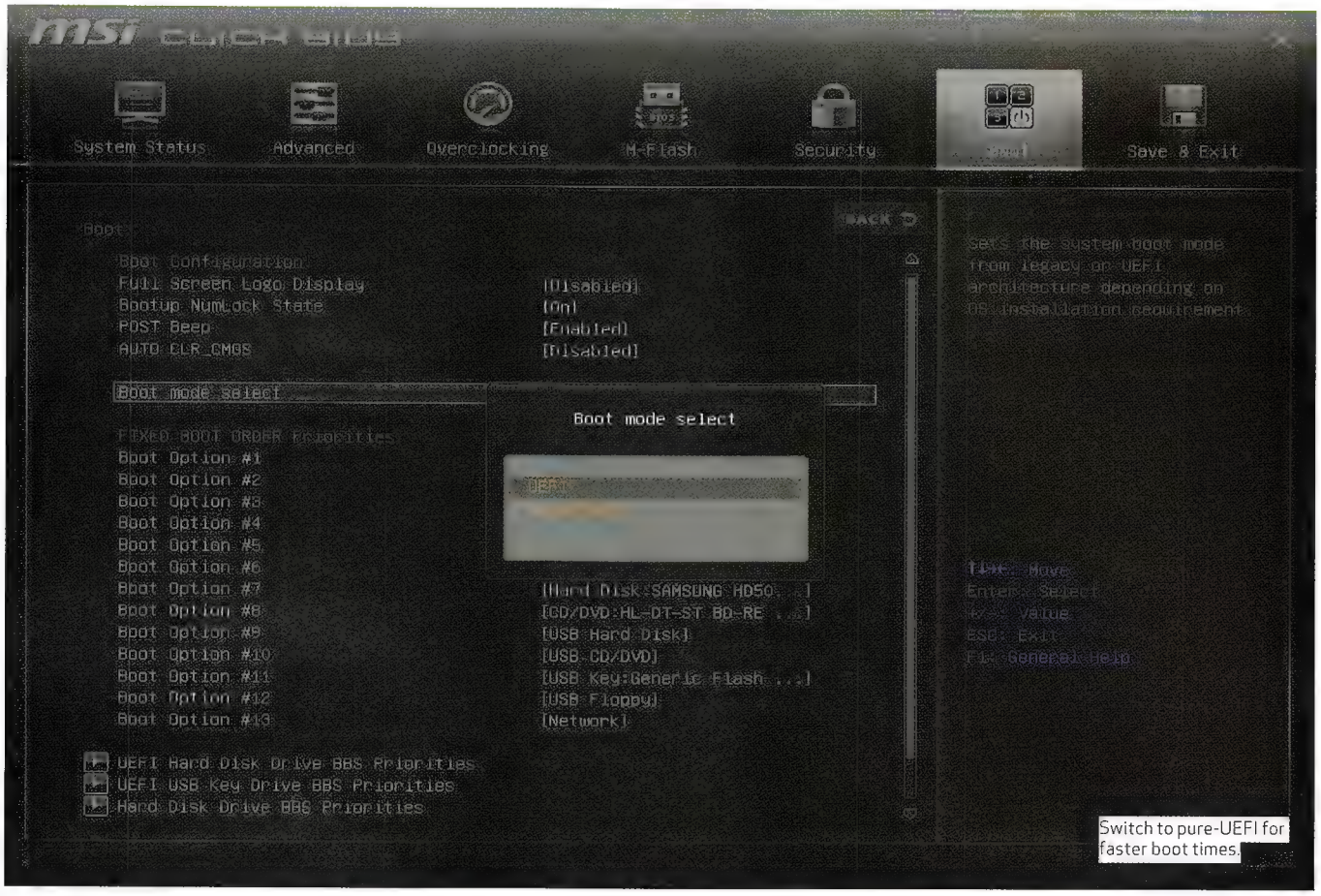
GETTING PREFERENCE CHANGES TO STICK

I've been trying to change a hidden setting in a preferences file, but can't get it to stick. Any idea what am I doing wrong?
Alison Williams

Don't be fooled into thinking that what you see and can change in the Property Lists in a Library/Preferences folder controls those settings. This is because apps generally don't access those preferences directly, but through a server built into macOS named cfprefsd. That loads the settings into its cache, and may keep them there even when the application is no longer running. When you open one of those files and make changes, you won't change the data that's being cached by cfprefsd, and when it's written back to the preferences file, that will overwrite any changes you made. The same can apply to files which appear to be broken, so you've thrown them into the Trash – they may simply be recreated by macOS.



Editing preference files directly is usually unsuccessful – use a purpose-designed utility like the free Prefs Editor instead.



There are two reliable ways to make changes to Preferences files so they stick: one is using the defaults command in Terminal's command line, which is often used in recipes to change features in Finder. The other is to use an app that works with rather than against cfprefsd, such as Thomas Tempelmann's free Prefs Editor (**apps.tempel.org/index.php**).

HARDWARE

PC SLOW TO REACH POST

I've just bought a new PC with MSI X470 Gaming Pro motherboard, and it's lightning quick – except for one crucial aspect. It takes as long (around 20 seconds) to display the POST as it does to boot into Windows. Can you help eliminate this annoying delay?
Frank Charlton

Sadly, this is normal behaviour on many MSI motherboards, but there are some things you can do to improve matters – one of which is to head into the BIOS, switch to the Boot tab and ensure 'Boot mode select' is set to UEFI as opposed to 'Legacy + UEFI'. Frank had also installed a BIOS update to extend compatibility to the latest Ryzen 3000-series chips – unless you're intending to install such a chip, we recommend avoiding this update as it's also been known to slow down the POST process.
Carrie Marshall

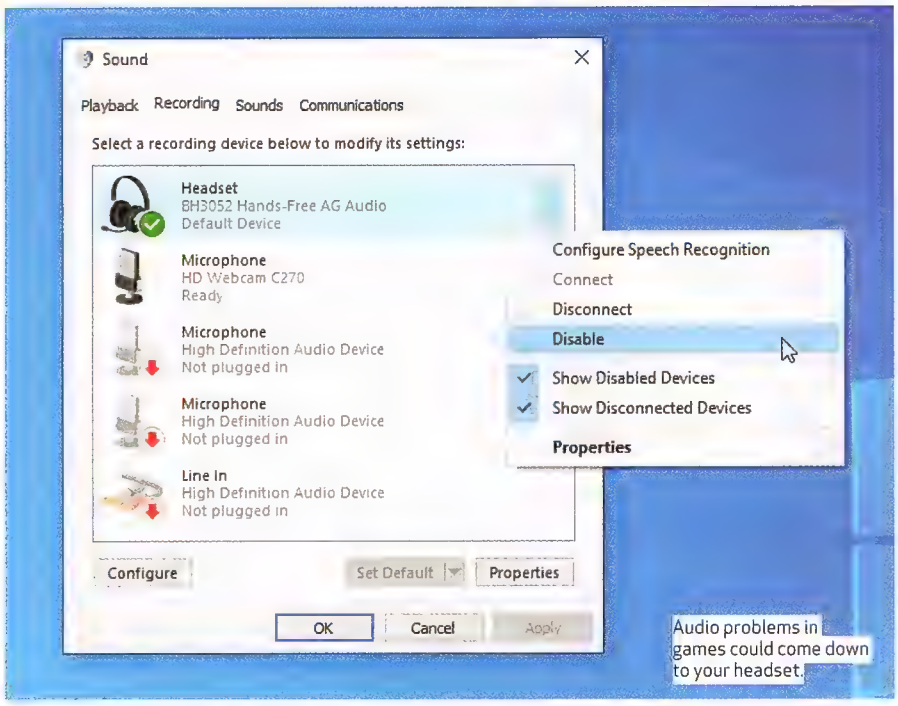
MICROSOFT STORE

DVD PLAYER APP MISSING

I purchased the Windows DVD Player app from the Microsoft Store, paying $22.45 by PayPal. A few days ago, I was forced to reset my laptop, after which this app had disappeared. I've tried to get help from Microsoft support, but it's been a very frustrating exercise. Can you please help?
Will Jobling

Ordinarily, any software you've purchased through the Microsoft Store should be available to download again after reinstalling Windows. Open the Store, verify you're logged into the correct account and then click the '...' button and choose 'My Library' to view all previous purchases and installations. Select 'Ready to install' to filter the list further if necessary.

After Microsoft instructed Will to pay for the app again, he decided to look elsewhere. Luckily, armed with our advice he was more than happy



Audio problems in games could come down to your headset.

to install the completely free VLC Media Player.

(**www.videolan.org/vlc**) instead.

Catherine Ellis

GAMING

BLUETOOTH AUDIO PROBLEM

When using my Bluetooth headphones and playing a game, the sound often cuts out when the game starts, having played perfectly well before opening the game, and on the game's menu screen. Open the game, however, and after a short crackle it's completely silent. This behaviour isn't consistent with every game and makes me wonder if it's something to do with DirectX. Any pointers?

Dean Vineen

We traced the cause of this problem to the Bluetooth headphones' built-in mic. Many users have complained of similar issues, and the workaround for those who don't use the mic is to simply disable it: right-click the speaker icon in the Taskbar notification area and choose 'Open Sound settings'. Scroll down to the Related Settings section and click 'Sound Control Panel'. Switch to the Recording tab, right-click your Headset's entry and choose Disable, which should resolve the problem.

Nick Peers

INTERNET

CAN WI-FI BOOSTERS IMPROVE MY INTERNET CONNECTION?

I have seen numerous adverts relating to a Wi-Fi booster that claims to provide stronger broadband throughout the house. It also alleges to provide a stronger, faster broadband download speed. This suggests that broadband providers don't give you the speed initially promised?

Harold Haywood

Wi-Fi signal boosters have no effect on the speed of your internet connection as it's delivered to your home by your broadband provider, but they can improve download speeds over Wi-Fi. To see how this works, first visit **www.speedtest.net** in your browser on a PC connected to your router modem via Ethernet cable. The results here provide the benchmark speed of your internet connection to your home.

Now repeat the test on a Wi-Fi-enabled device (if you're on a mobile, install the free Speedtest app) at different points in your home. You'll see the results vary, with download speeds dropping off the further you travel from your router. A Wi-Fi booster simply acts to relay signals to hard-to-reach places in your home, boosting download speeds to the levels enjoyed by your wired devices.

Alex Cox

WINDOWS

DUAL-BOOT WINDOWS 7 AND WINDOWS 10

The pressure to upgrade is mounting, but I'm not ready to give up on Windows 7 yet. I'd like to install a second SSD in my PC and install Windows 10 on a separate drive. Is there some way to choose which system to boot into on startup?

Tim Kaye

First, install your new drive and boot into Windows 7. Press Win-R, type 'diskmgmt.msc' and hit Enter. Scroll down to locate the new drive. Right-click the drive's unallocated space and choose Initialise. Choose 'GPT (GUID Partition Table)' and click OK. Next, prepare your Windows installation media on DVD or USB flash drive using the Media Creation Tool (**http://bit.ly/msmctool**). Following on from this, reboot with the installation media plugged in and opt to boot from the drive when prompted. Now simply follow through a regular Windows install process: choose custom when prompted and be sure to select your new drive as the target for the new installation. The installer will detect the presence of Windows 7 and will set up a dual-boot menu to allow you to switch between Windows 7 and 10 each time you start your PC.

Ian Sleightholm

HARDWARE

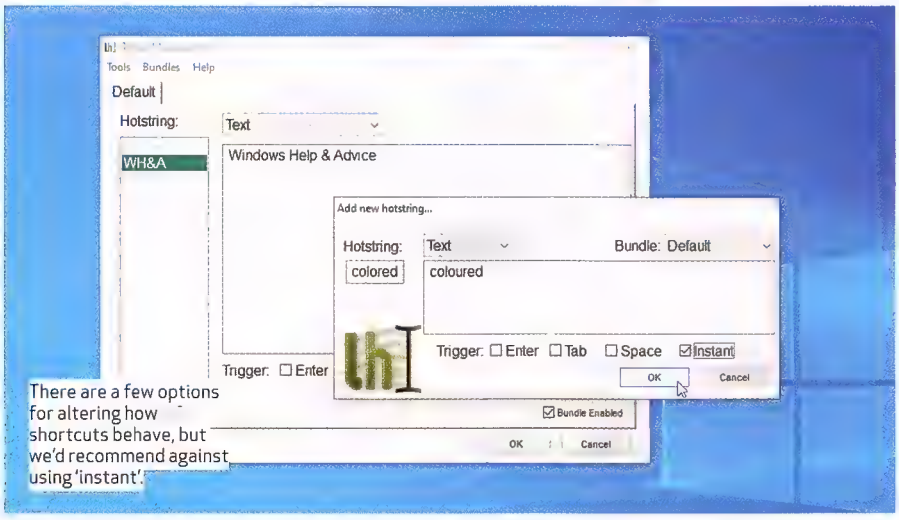
UPDATING DRIVERS

What's your recommendation on updating drivers? Let Windows Update handle it, use a third-party tool like DriverBooster, or some other option?

Ebi Baqri

Improve wireless performance with a Wi-Fi booster.

Driver Booster 7 FREE
Installing: (2%)
Realtek PCIe GbE Family Controller
Automatically reboot PC
Upgrade to PRO edition to update more device drivers & game components.
Outdated (total: 9, selected: 9)
Display adaptors
NVIDIA GeForce GT 1030
IDE ATA/ATAPI controllers
Standard SATA AHCI Controller
Sound, video and game controllers
NVIDIA High Definition Audio
Mice and other pointing devices
HID-compliant mouse
Network adapters
Realtek PCIe GbE Family Controller
Storage controllers
USB Attached SCSI (UAS) Mass Storage Device
Universal Serial Bus controllers
USB Mass Storage Device
Activate Now!
DriverBooster can track down elusive driver updates.



There are a few options for altering how shortcuts behave, but we'd recommend against using 'instant'.

Broadly speaking, if your computer is working as you expect it to, then it's best to leave Windows Update in charge of driver updates. There are, of course, exceptions. If you're a gamer, for example, then you'll want the latest graphics drivers your card supports – install the latest one from Nvidia or AMD and it'll will keep itself updated going forward. Another reason for sourcing and downloading drivers yourself is to troubleshoot problems you believe related to hardware. Start by visiting the support or downloads section of the relevant manufacturer – peripheral, component, motherboard or PC – to see if newer drivers are available (along with tools for keeping those drivers updated in the future). Tools like DriverBooster (**www.iobit.com/en/driver-booster.php**) come into their own for keeping all your drivers updated for performance reasons, but also come in handy when you're struggling to find drivers for your system – for example, when your hardware manufacturer stops supporting a particular product.

Nick Peers

WORD PROCESSING
GET A SYSTEM-WIDE AUTOCORRECT TOOL

Can you suggest a free autocorrect tool that works outside of Microsoft Word?

Try Texter – visit **bit.ly/texter-win** for download links. Although 12 years old, it works perfectly in Windows 10. It's a text substitution app that saves you countless keystrokes by replacing abbreviations with commonly used phrases you define. Here's a quick guide to how it works.

After installing (or adding to your portable toolkit), launch Texter – it'll appear in your Taskbar notification area. First steps is to right-click this icon and choose Manage Hotstrings to bring up the main Texter Management window.

Hotstrings work in the same way as autocorrect entries in Word. Click the '+' button to create your first hotstring. Type the shortcut or frequently misspelled word into the Hotstring box and the correct text where directed.

You'll see four options for triggers: pressing Enter, Tab, or Space, or 'Instant' which means the text is automatically changed as soon as it's typed. We'd recommend 'Instant' for misspelled entries only; other shortcuts should have a trigger.

Open any program and type the misspelling or hotstring before (if applicable) clicking the trigger key. You'll see the text magically change along with a sound effect. Choose Tools > Preferences to configure Texter further.

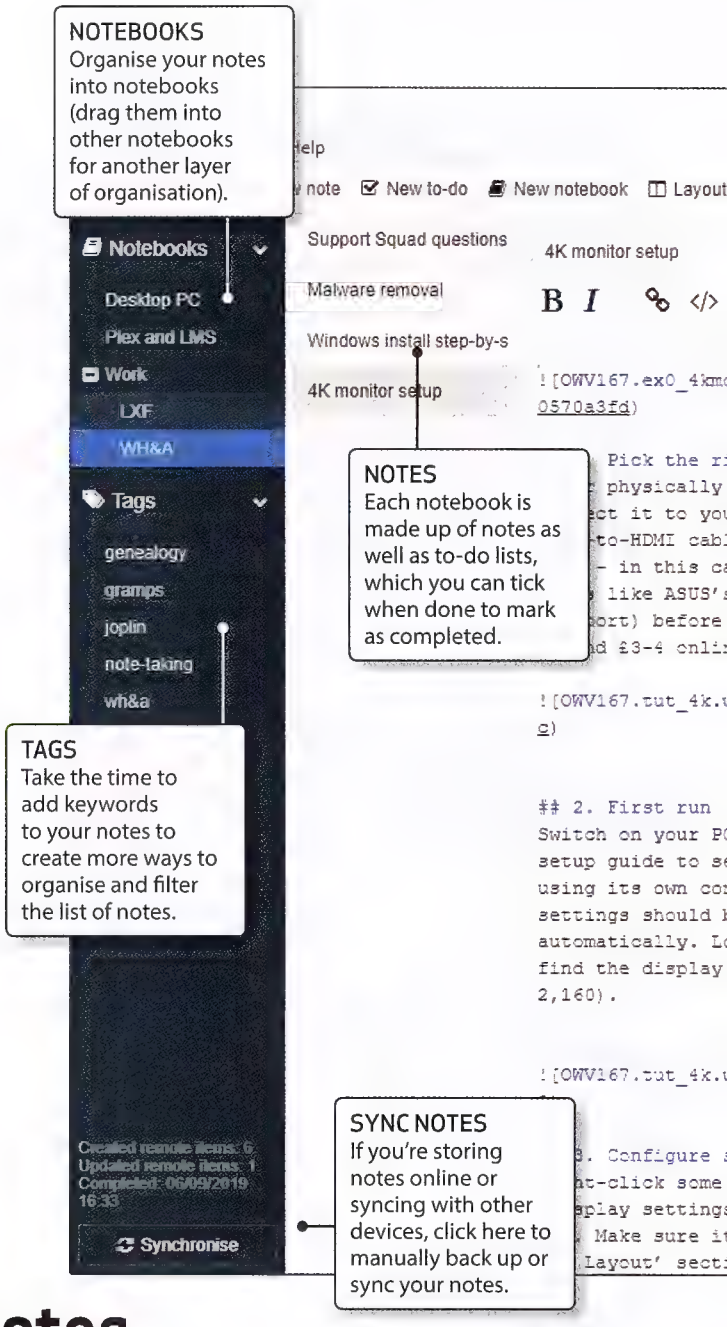
Catherine Ellis

Edit and sync notes securely

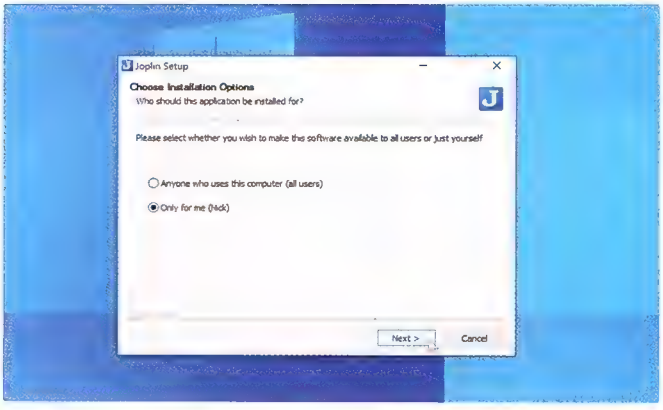
Joplin is the perfect note-taking tool. Nick Peers gets you started with this powerful and completely free app.

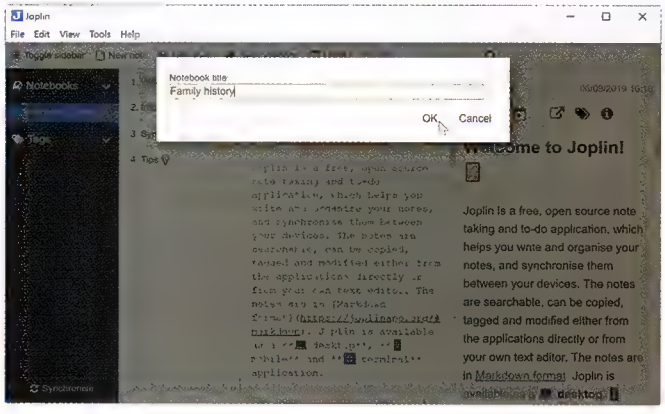
We've spent a long time trying to find the perfect note-taking service, and we've finally struck gold in the form of Joplin. It's free and open source, plus works across all major desktop and mobile platforms – including Android and iOS – so you can access and update your notes from anywhere. When it comes to syncing notes, you're fully in control: you choose which cloud platform to use and can optionally encrypt your notes to provide an extra layer of protection.

You can also add note-clipping capabilities to your Firefox or Chrome web browser. Last, but not least, Joplin is perfect whether you want to record quick text-based notes or emulate the rich features found in Evernote, from fully styled text to support for images and file attachments. Joplin is everything you ever wanted in a note-taking tool – read on to start using it.


NOTEBOOKS
Organise your notes into notebooks (drag them into other notebooks for another layer of organisation).
NOTES
Each notebook is made up of notes as well as to-do lists, which you can tick when done to mark as completed.
TAGS
Take the time to add keywords to your notes to create more ways to organise and filter the list of notes.
SYNC NOTES
If you're storing notes online or syncing with other devices, click here to manually back up or sync your notes.
Notebooks
Desktop PC
Plex and LMS
Work
LXF
WH&A
Tags
genealogy
gramps
joplin
note-taking
wh&a
Synchronise
note
New to-do
New notebook
Support Squad questions
Malware removal
Windows install step-by-s
4K monitor setup

Set up, use and sync notes


Joplin Setup
Choose Installation Options
Who should this application be installed for?
Please select whether you wish to make this software available to all users or just yourself
Anyone who uses this computer (all users)
Only for me (Nick)
Next >
Cancel


Joplin
File Edit View Tools Help
Notebook title
Family history
OK
Cancel
Welcome to Joplin!
Joplin is a free, open source note taking and to-do application, which helps you write and organise your notes, and synchronise them between your devices. The notes are searchable, can be copied, tagged and modified either from the applications directly or from your own text editor. The notes are in Markdown format. Joplin is

1 INSTALL JOPLIN

Open your browser, go to **https://joplinapp.org** – scroll down the page for the download link. The 'Get it on Windows' link is a traditional installer or you can click on the 'Portable version' link for a single self-contained file (JoplinPortable.exe). If installing, you can choose to install it for just yourself or other users of your PC too. Once installed, let Joplin launch.

2 REVIEW USER INTERFACE

The annotation reveals how Joplin organises your notes using a series of notebooks, with keyword tags available to help produce filtered views. Start by clicking the 'New notebook' button to store your first related set of notes in. Give it a suitable name and click OK. If you need another layer of organisation, you can create notebooks to nest inside other notebooks too.

MARKDOWN
Markdown controls are found on the toolbar, or you can input them (and HTML-style codes) directly into a note.
EDIT AND PREVIEW
Type your note or make changes in the left-hand pane; the right-hand pane shows your post with all formatting.
06/09/2019 16:32
1. Pick the right cable and port
After physically setting up your monitor, you'll need to connect it to your PC. This may be a straightforward HDMI-to-HDMI cable, or you may find your PC only has a DVI port – in this case, verify it supports 4K (some lower end cards like ASUS's GT1030-SL-2G don't support 4K through the DVI port) before purchasing a HDMI-to-DVI cable or adapter – around £3-4 online.

NICK'S BEST TIP

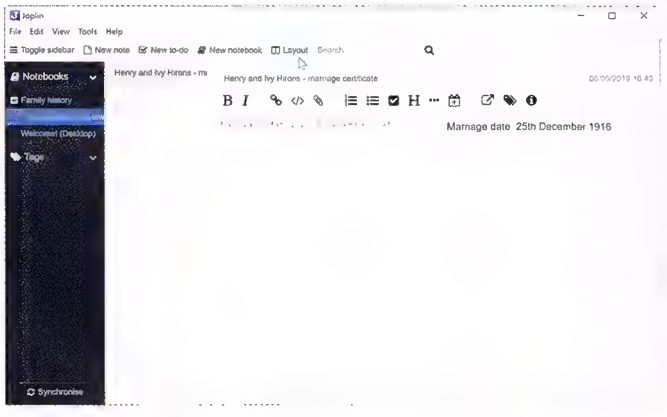
Export your notes from Evernote as an ENEX file, then import them into Joplin via the File > Import menu.

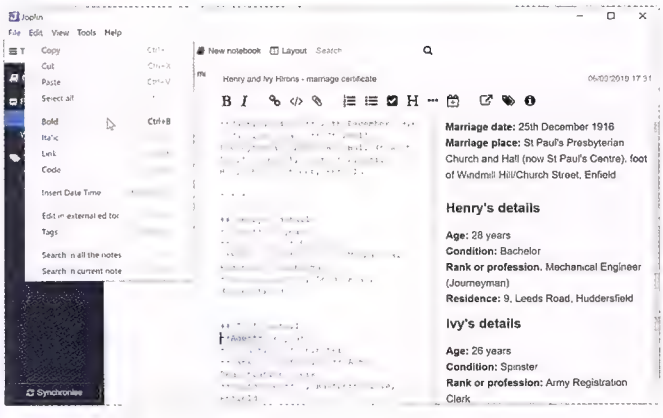
JARGON BUSTER!

MARKDOWN
A lightweight markup language that is designed to denote how to style text – for example ** indicates bold – in plain text files.

HTML STYLES
Joplin allows users to style notes using HTML code as an alternative to Markdown where styles aren't available – for example, <s></s> for strikethrough.

WEBDAV
A means of creating, moving and deleting files on a server through standard (HTTP) connections.



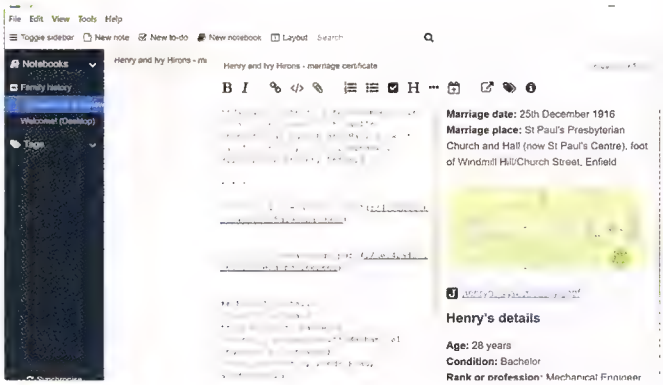

Joplin
File Edit View Tools Help
Marriage date: 25th December 1916
Marriage place: St Paul's Presbyterian Church and Hall (now St Paul's Centre), foot of Windmill Hill/Church Street, Enfield
Henry's details
Age: 28 years
Condition: Bachelor
Rank or profession: Mechanical Engineer (Journeyman)
Residence: 9, Leeds Road, Huddersfield
Ivy's details
Age: 26 years
Condition: Spinster
Rank or profession: Army Registration Clerk

3 CREATE YOUR FIRST NOTE

Tap 'New note' to create a new note and open the dual-paned edit/preview window. Give it a title, then start typing in the left-hand pane – changes are saved as you make them. You'll see the right-hand pane mirrors what you type. Click the Layout button once to hide the preview window (click again to show only the preview window, and again to bring back both.

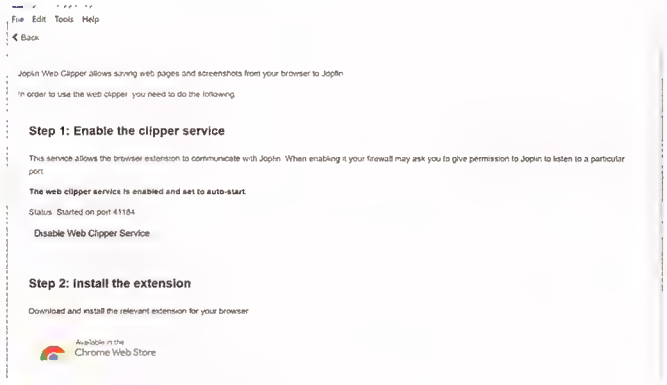
4 STYLE UP YOUR NOTE

Keep typing. You'll see a series of buttons above the edit window that allow you to style up your text in various ways – these insert Markdown characters (such as ** for bold) that appear in the edit pane, while the preview pane shows how the note will look. You can also style using HTML code, apply headings and add lists, hyperlinks, horizontal lines and tick boxes.


Marriage date: 25th December 1916
Marriage place: St Paul's Presbyterian Church and Hall (now St Paul's Centre), foot of Windmill Hill/Church Street, Enfield
Henry's details
Age: 28 years
Condition: Bachelor

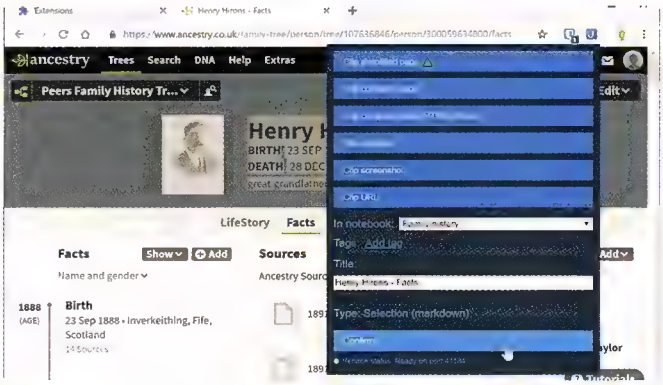
5 ATTACH FILES

You can also attach files to your notes. Either drag the file into your note from a File Explorer window or position the cursor within your note and click the paperclip button to select it. A clickable link to the file will appear unless it's an image, in which case the image itself is displayed. Hold Alt as you drag an image on to the note to create a link instead of displaying it.



6 ENABLE WEB CLIPPER

Both Firefox and Chrome web browsers offer a free Web Clipper tool for generating notes from all or part of web pages. First, open 'Tools > Web clipper options' in Joplin. Click 'Enable Web Clipper Service', then click the appropriate link to locate and add the extension for Chrome and/or Firefox. You should see the Joplin icon appear in your browser's toolbar.

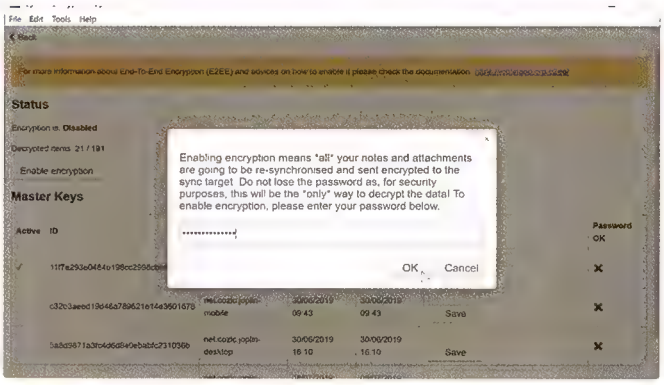


7 CLIP WEB PAGES

Once set up, browse to a web page containing content you want to use, then click the Joplin button to bring up a list of options. You can clip the complete page (including a simplified note-friendly version), or choose to clip selected content, a screenshot of the page or a URL. Choose a notebook, give your note a suitable name, add tags and finally click Confirm.

8 BACK UP AND SYNC NOTES

Joplin works best across multiple desktop and mobile devices. For this to work you need to set up synchronisation using a third-party service to store the notes – supported services include Dropbox, OneDrive (our choice here), Nextcloud, file system (a local network folder) and WebDAV-compatible services. Make your choice and click OK followed by Synchronise.

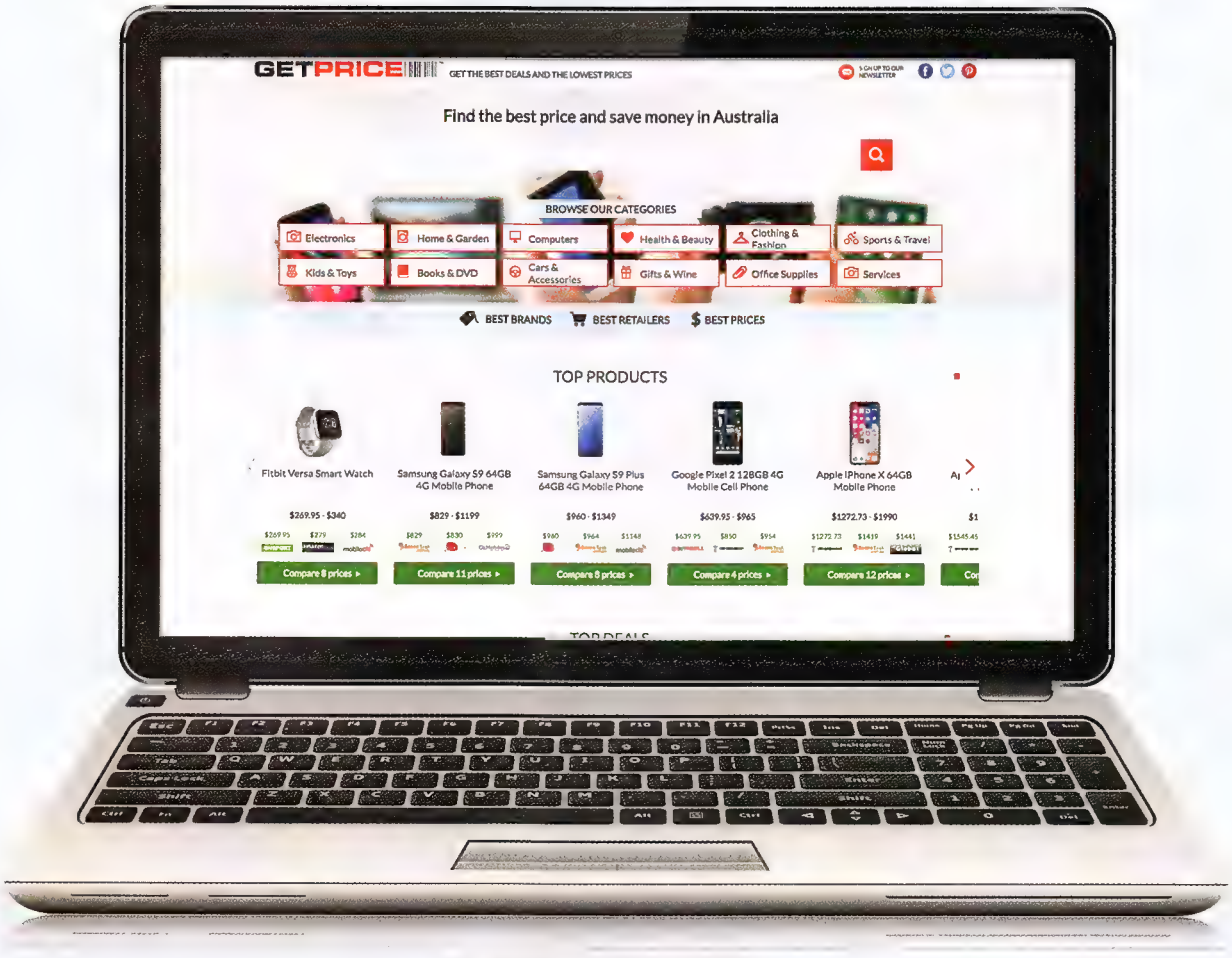

Status
Master Keys
Enabling encryption means "all" your notes and attachments are going to be re-synchronised and sent encrypted to the sync target. Do not lose the password as, for security purposes, this will be the "only" way to decrypt the data! To enable encryption, please enter your password below.
OK
Cancel

9 ENCRYPT YOUR NOTES

The first time you try to sync you'll be prompted to sign into the service you're using. Once done, your notes will be synced. By default, they're unencrypted, so choose 'Tools > Encryption options' and click 'Enable encryption' to protect them. You'll be prompted for a master password – make it strong, but memorable – then click OK. Your notes will now be encrypted when synced.

10 STAY IN SYNC

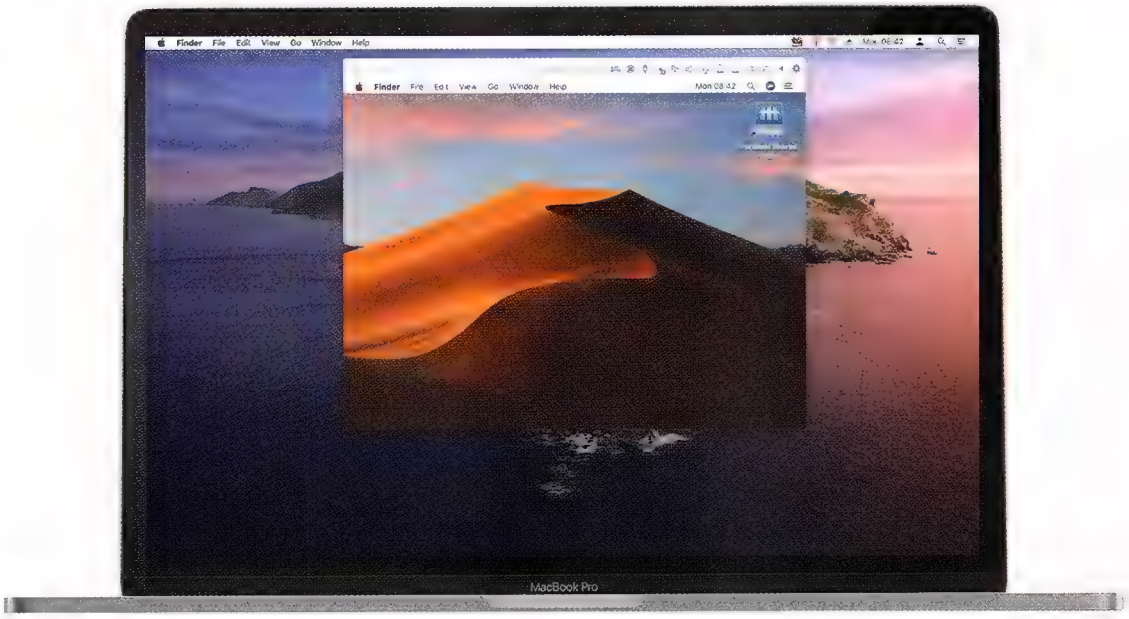
When you set up Joplin on another device and choose to synchronise using the same online service, you'll automatically download any notes stored in the cloud. Make sure you choose 'Tools > Encryption options' where you'll need to enter any master passwords from other devices to decrypt notes created on those devices. Your secure, synced note-taking system is now in place.



Find the best prices on the latest tech.

www.getprice.com.au

GETPRICE™



Run 32-bit apps in Catalina

Howard Oakley shows how to keep key 32-bit apps running after you've upgraded to macOS 10.15.

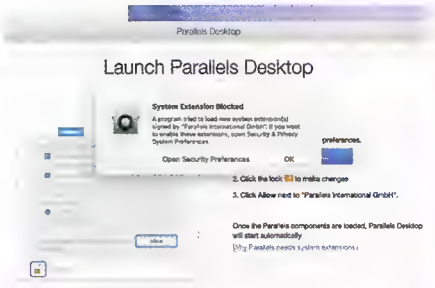
You can upgrade to macOS Catalina even when you still need to run apps which are 32-bit or incompatible with 10.15. If you don't need to run both versions of macOS at the same time, you can install Catalina into a separate volume or partition, and then switch between them using the Startup Disk pane.

Installing an older version of macOS in a Virtual Machine (VM) is often a better solution, as you can copy and paste between older apps and Catalina, and share documents easily. For this, use either of the major virtualisation apps, VMware Fusion or Parallels Desktop; here we'll show the latter, as version 15 is already fully compatible with Catalina.

The trickiest task is obtaining a full installer of macOS 10.14.6 or earlier. Apple sometimes hides them away in the App Store after a new version is released. Your Mac will in any case be unable to download a version which is too old to install on it.

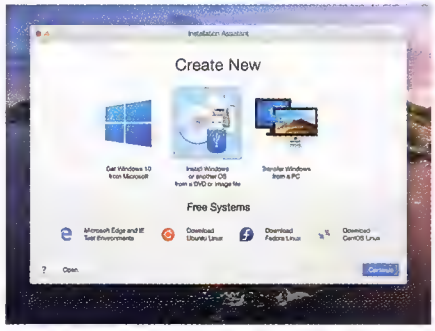
Use only official sources.

Run 32-bit apps in macOS Catalina



1 ENABLE THE EXTENSION

If installing for the first time, follow directions so that Parallels' system extension isn't blocked. In Catalina, this requires a restart after agreeing in the Security pane, and installation resumes afterwards.

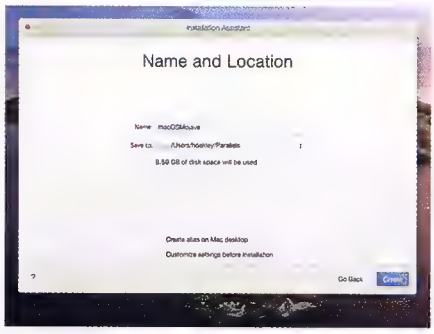


2 CREATE A NEW VM

Once signed into your Parallels account, enter the activation key, and consent to access to various folders. You'll be asked to create a new VM. Select the middle of the three options to use your macOS installer.

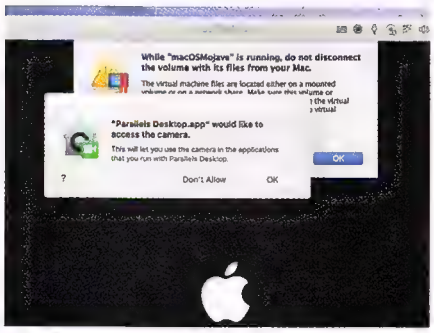
3 SELECT THE INSTALLER

If it doesn't find the right installer, click on Select a file…, and switch the Open File dialog to display All files (*). Open your macOS installer, agree creation of a bootable disk image file, and click Continue.



4 SAVE THE NEW VM

Give the VM a suitable name, and choose its location. The default of a Parallels folder in your Home folder is usually best, unless you've very good reasons to put it somewhere more suitable. Click on Continue.


While "macOSMojave" is running, do not disconnect the volume with its files from your Mac.
"Parallels Desktop.app" would like to access the camera.
Don't Allow
OK

5 GIVE PRIVACY CONSENT

Install Parallels Toolbox when asked, so it can download. Meanwhile, in the VM, macOS should start up in Recovery Mode. As privacy consent dialogs appear, agree to them so your VM can access all your Mac's features.

6 START INSTALLING MACOS

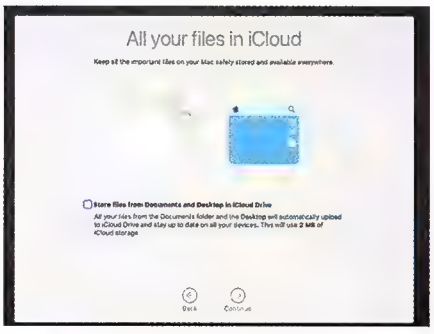
The VM displays normal Recovery Mode options. Select Install macOS and click on Continue to start installing it into your VM. This is by far the longest part of the process, and an opportunity to stretch your legs.

7 SELECT VIRTUAL VOLUME

Once you've seen the normal installer splash screen, select the disk named Macintosh HD onto which to perform the installation. This isn't your Mac's real startup disk, but Parallels' virtual volume. Click on Install.

8 SIGN INTO YOUR APPLEID

After creating a user account and password, most choices made during installation are straightforward. It's useful to sign in with your normal Apple ID to ensure access to your App Store purchases and iCloud Drive.



9 MINIMISE ICLOUD USE

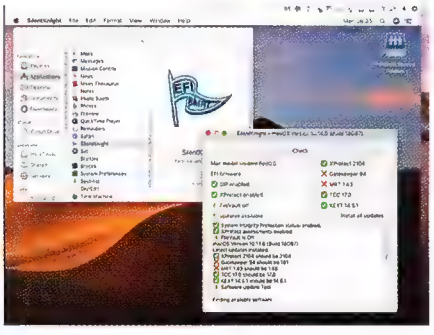
One option to avoid is putting your Documents and Desktop folders in iCloud from the VM, as this can cause complications and significant overhead when exchanging files with your normal Mac using Parallels Toolbox.

10 TURN FILEVAULT OFF

Another option to avoid is encryption of the virtual drive. If you need to protect its data, you're better off running from a volume with FileVault turned on, preferably via a T2 chip with its negligible overhead.

11 INSTALL PARALLELS TOOLS

Once your VM has configured macOS, open the Parallels Tools disk image on its Desktop, and run the installer to provide the rest of the tools to control the VM and integrate file exchange. Once complete, eject it.



12 UPDATE AND INSTALL

Install apps via Parallels Shared Folders. Check your VM connects with Apple's update servers to install security updates. SilentKnight (free, **eclecticlight.co**) helps get this done. Then set your 32-bit apps up and run them.

Master the Apple TV app

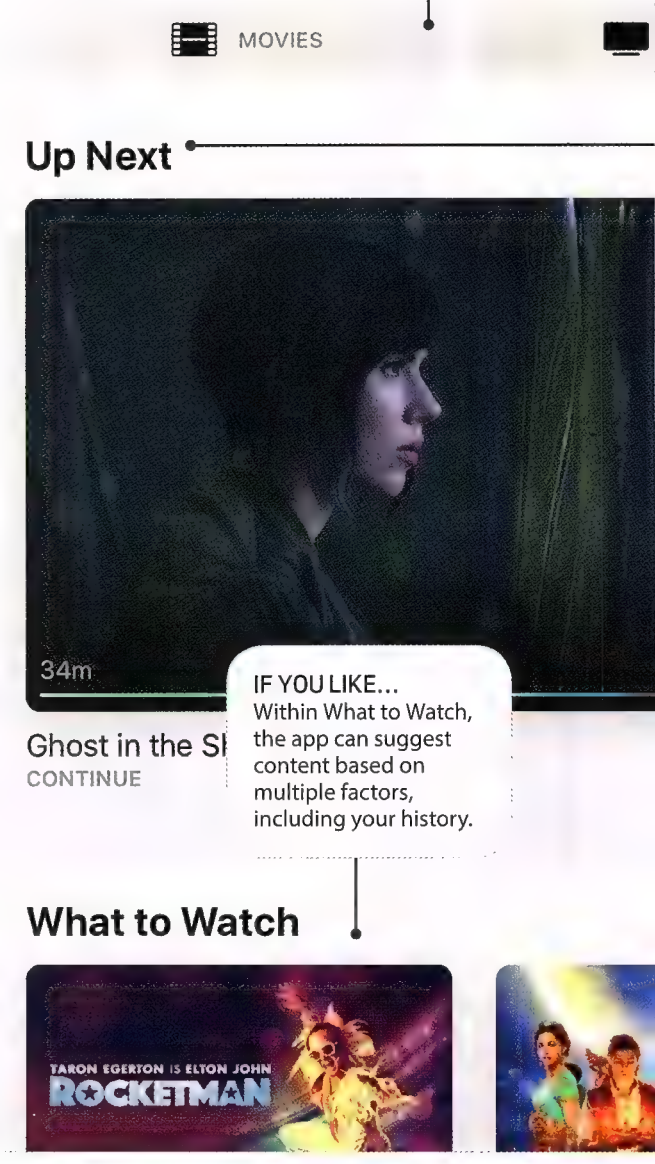
Srivats Lakshman helps you discover something new from all your services in one place.

Rather than going through several apps, the Apple TV app on iOS, iPadOS, macOS and tvOS gives you a single place to discover and watch films and TV shows.

The Apple TV app syncs across your devices, so you can start watching on one device and pick up where you left off on another. Rather than open multiple apps, Apple TV lets you access content from a range of content providers.

The Apple TV app also enables you to preview shows before deciding whether you want to pay for a particular subscription channel. And, of course, you can view iTunes material.

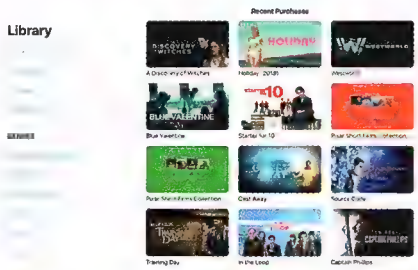
You can download shows for offline viewing and watch trailers, and access related show info too. The app will also soon be home to the Apple TV+ service.


Watch Now
SEARCH BY TYPE
If you aren't sure what you want to watch, you can filter your options by kids' content, TV shows or films.
MOVIES
Up Next
34m
Ghost in the Sh
CONTINUE
IF YOU LIKE...
Within What to Watch, the app can suggest content based on multiple factors, including your history.
What to Watch
TARON EGERTON IS ELTON JOHN
ROCKETMAN

Find your way round the Apple TV app

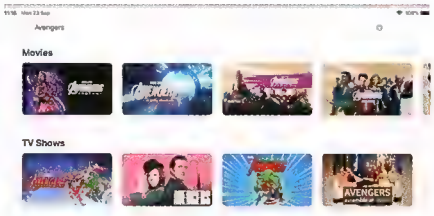
1 WATCH NOW

The first tab on Watch Now is Up Next and this shows what you're currently watching. What to Watch provides suggestions from connected services, trending films and shows. You can also access AppleTV+ shows from this screen.



2 LIBRARY

The second tab enables you to view your iTunes purchases. You can break down this view by genre or type. If you don't purchase or rent content through iTunes, you will see 'You don't have any videos' on the screen.



3 USE THE SEARCH BAR

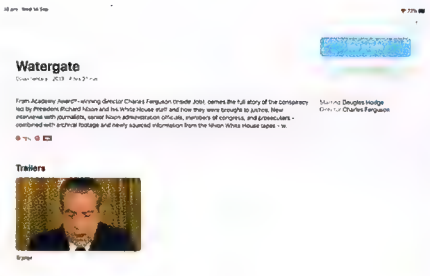
Like the Music app, the search option lets you comb through the vast iTunes catalogue to find the film or TV show you want. You can also search content from your subscription channels. This screen also shows trending content.

OWS
KIDS
CONTINUE
With Up Next, you can continue watching all your content right where you left off, whether it was on your iPad, iPhone, Mac or Apple TV.
YOUR APPLE ID
All your account info is stored here. You can view connected apps, manage subscriptions and redeem gift cards.
A DISCOVERY OF WITCHES
A Discovery of Witches
NEXT · S1, E4
Hol
PUR
See All
Aladdin
BBC
LOVE IN THE COUNTRYSIDE
NIGHT HUNTER

GENIUS TIP

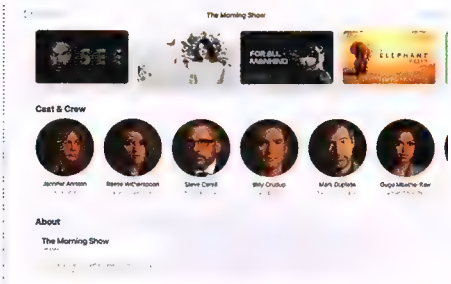
iTunes rentals can be watched any time up to 30 days after the start of the rental. Once you start watching, you have 48 hours to finish.

Got a friend who'd enjoy a film or show? Click Share in the top-right corner to send them a link via Mail, Messages and more



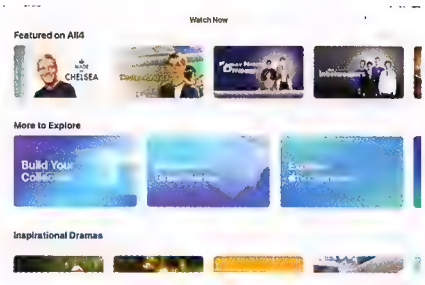
4 VIEW MORE INFO

If you want to know more about a show or film, tapping on it will let you view the cast and crew, storyline, age rating and Rotten Tomatoes' score. You can buy, rent, add to Up Next or share the link from here.



5 ACCESS APPLE TV+

The Apple TV app will be home to Apple's new streaming service. Like other channels, you'll be able to view Apple TV+ trailers, get info and see related content. Again, you can download Apple TV+ content for later viewing.



6 SEE SUGGESTIONS

Below the Apple TV+ section, you can find more suggestions. As well as Trending, New Movies, New & Noteworthy and More to Explore sections, you'll see plenty of categories, so you always have something fresh to discover.

How to keep your Raspberry Pi 4 cool

Les Pounder shows us how to keep the new Raspberry Pi 4 cool, even under heavy workloads, using bolt-ons.

The Raspberry Pi has seen great increases in CPU speed since 2012. From a single-core 700MHz CPU to the latest Pi 4 and a 1.5GHz quad-core CPU is quite a difference, and with this increase in power there is an inevitable increase in heat. The Raspberry Pi 4 has a rather warm CPU: a stock Pi can idle at 39°C, and under extended heavy load it can reach up to 80°C! There are now many companies offering their version of a cooling system to help prolong the life of the Pi 4 and stop our fingers getting burnt. But which is the most effective? Which is the cheapest? And do we need passive or active cooling?

PASSIVE VS ACTIVE COOLING

Passive cooling is when a CPU is cooled using a heatsink or pipe, which draws away the heat from the CPU to a series of thin metals fins that are designed to offer the most surface area from which the heat can dissipate. CPUs have used heatsinks since the late 386 devices, and this was enough for most CPUs.

But with the rise of the Pentium era, extra cooling was required and this is where active cooling became the norm. With the more powerful Pentium CPUs generating more heat as their speed increased, heatsinks were no longer enough and fans were needed to whisk the heat away from the CPU.

It has now become the norm for PCs to have many fans to keep everything cool, and with the Pi 4 now running a more powerful CPU, the need for active cooling has arrived.

But which is best for our Raspberry Pi 4? Let's find out!

HOT STUFF

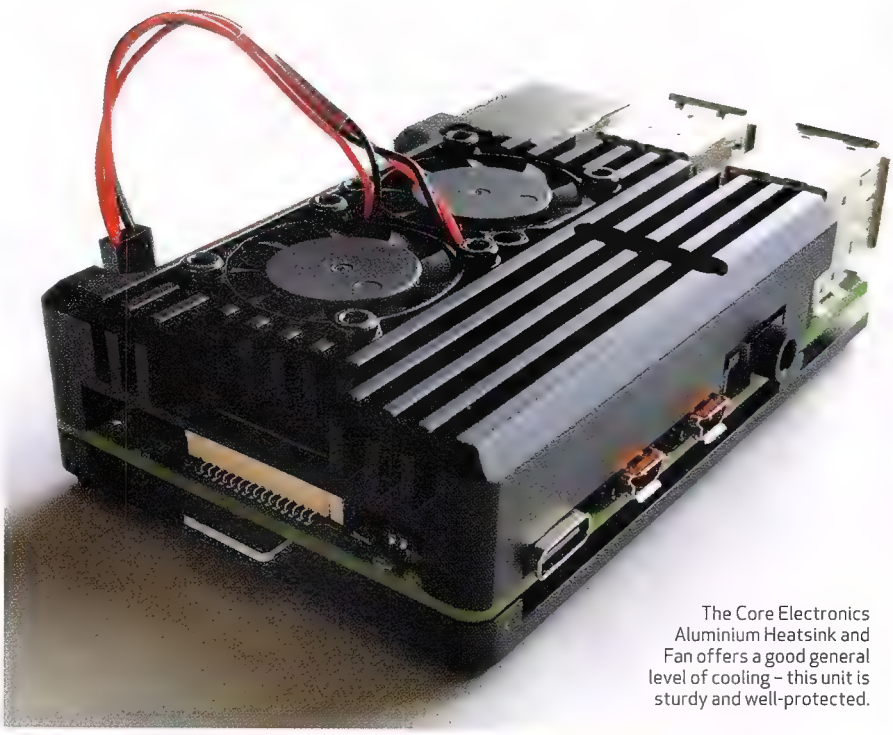
We used a Raspberry Pi 4 running the latest version of Raspbian, and with the firmware updated to the latest available. For each test the Pi was allowed to rest and stabilise temperature for five minutes before a test was run. Each cooling unit was used with the stock equipment/accessories which it came with.

The test involved running Sysbench to verify prime numbers between 2 and 50,000, and used all four cores of the CPU. The data was collected using a Python script which ran every minute and collected the current time, CPU temperature and CPU speed. This was then saved to a CSV file and edited in a spreadsheet. We also looked at whether the cooling systems gave decent access to the GPIO pins, Camera (CSI) and Display (DSI), and Power over Ethernet (PoE) – plus their ease of assembly.

A stock Raspberry Pi 4 can quite happily run without much issue if used as a generic computer, or in projects that use the GPIO. If we push the Pi past 80°C then the CPU will throttle the speed in order to cool itself. This drop in speed is noticeable to users as it causes applications and the operating system to slow down or halt if pushed too far.

If you need to keep your Pi 4 running at top speed for longer, cooling is

It may look like a BBQ grill, but the Pimoroni Aluminium case offered acceptable cooling for low-noise projects.



The Core Electronics Aluminium Heatsink and Fan offers a good general level of cooling – this unit is sturdy and well-protected.

required, and here are five cooling solutions that we tested for you.

PIMORONI ALUMINIUM HEATSINK CASE

For passive cooling – with no moving parts, just a large heatsink – the current best solution is the Aluminium Heatsink Case from Pimoroni. Coming as a two-part metal kit with four hex screws, this case is super-simple to assemble, requiring only that we apply the thermal pad to the CPU, then close up the case.

This silent cooling solution claims to drop 15°C from the stock CPU temperature, but in our tests it managed a drop of just 2°C. The supplied thermal pad was the issue – it only made partial contact with the case, as it was so thin. If passive cooling is your top priority, invest in a thicker thermal pad or use thermal paste to make good contact between the case and Pi.

That said, this case is very usable and does provide enough cooling to run a Pi 4 all day. It provides access to the GPIO, but a HAT board will need to use a header extension. Access to PoE, CSI and DSI connections are possible, but must be made before securing the case. The PoE connection is rather awkward to achieve, but possible with extension headers.

All of the other ports are exposed and easily accessible, including the microSD card port which is easy to access even for large hands. Consider this case if you need silent cooling and don't plan to overclock.

CORE ELECTRONICS ALUMINIUM HEATSINK

At first glance this looks just like Pimoroni's case, and yes, it is very close. But this version has two 20mm fans which are powered directly from the 5V and GND pins of the GPIO. The case can be used passively, with similar performance to Pimoroni's version. But adding the fans drops the idle temperature to 37°C, and under load for four minutes the temperature was 47°C – a full 16°C less than Pimoroni's. With great passive and active cooling this case can keep your Pi cool under load for a full day.

The case is made of two parts and they are secured together using four hex screws. It offers the same access to ports as the Pimoroni, including making connections to the CSI and DSI before closing the case. Fan noise is low, no louder than a typical laptop fan running at idle. If you want a solid case with good cooling, this is an ideal choice.

PIMORONI FAN SHIM

This is the smallest and cheapest active cooling solution. A shim is a board which connects to the GPIO while retaining access to the pins, thanks to a rather snug fit to the topmost series of pins. The Fan Shim offers excellent cooling when constantly turned on. At idle we see 29°C, the lowest temperature in our test, and under full load for four minutes the temperature was 45°C. This blows cold air directly onto the CPU and can be used all day.

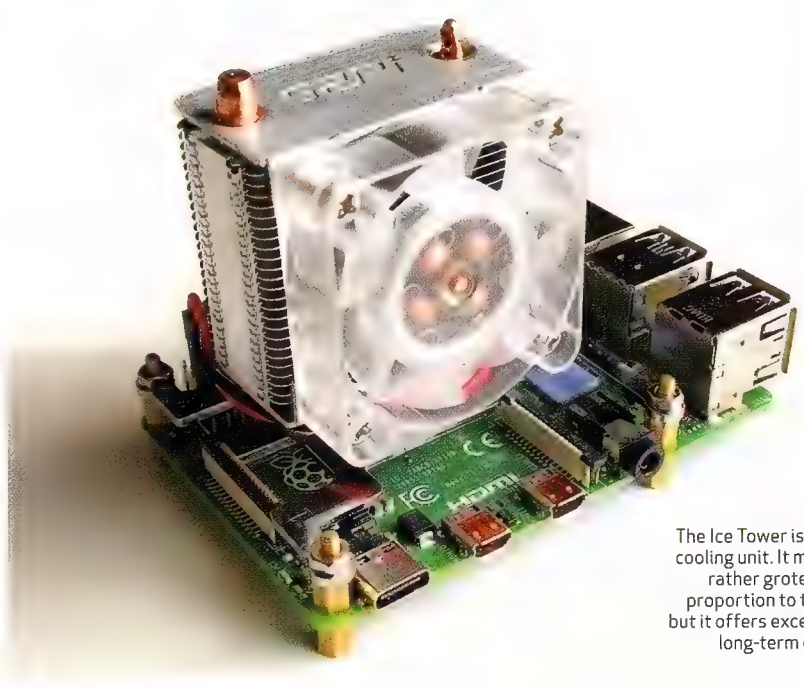
You can use a Python script to detect the CPU temperature via an onboard sensor. If the temperature goes over 65°C (by default), it will trigger the fan to come on, and if the temperature drops below 55°C the fan turns off. Of course, these values can be altered to suit your preferences.

The Fan Shim does not block access to any ports, and it can be used with Pimoroni's cases. It can be used with the PoE board but the clearance between the two is very tight. If you need a simple and effective cooling solution, this is the one!

GEEEKPI ALUMINIUM CASE

This is a cheap case and that was evident in the build quality, with

Don't be fooled by the size of the Pimoroni Fan Shim – it will keep your Pi 4 cool and retains access to the GPIO.



The Ice Tower is a great cooling unit. It may look rather grotesque in proportion to the Pi 4, but it offers exceptional long-term cooling.

sections of the aluminium case having nasty burrs. The case is relatively easy to assemble, coming as a series of aluminium sections held together with screws. A little force is required to ensure that the case is square, and in our build we had to move the microSD panel a little to ensure that the case fitted snugly around the Pi.

The Pi 4 is screwed to the bottom of the case, and held in place by the USB ports, which are rather close and could be bridged, creating a short circuit. Cooling is provided by a series of thermal pads and a 20mm heatsink and fan, powered by the GPIO. With an idle temperature of 37°C and under load a temperature of 56°C, this is a poor cooling option. It may keep the Pi cooler than stock when in all-day use, but the overall quality of the product lets it down.

Access to the GPIO is possible, except for the 5V and GND pins, which rules out the use of HATs. Camera (CSI) and Display (DSI) connections are not possible unless the case lid is removed. Adding the PoE board is impossible as the heatsink and fan will stop the board connecting to the GPIO. Access to the microSD port is rather awkward and requires tweezers to remove a card. In all, best to avoid this option.

52PI ICE TOWER

This is a beast of a cooling unit. Looking like an old Pentium 4 cooler, the Ice Tower sits atop the Pi4 via a custom holder which requires a little fiddling during assembly – but the included instructions are quite easy to follow. This big and brash cooler connects to the GPIO of the Pi, using the 5V and GND pins to power the RGB fan. With an idle temperature of 31°C and a temperature of 45°C when under load, this is an excellent cooling unit that will keep your Pi 4 cool all day if necessary.

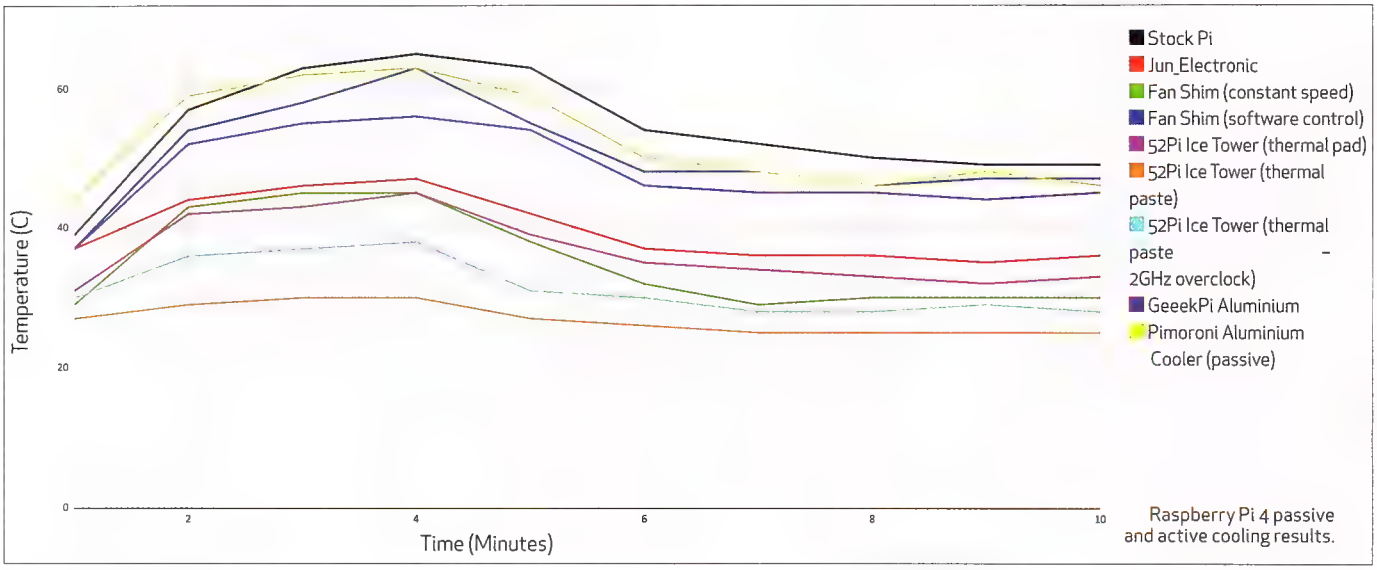
Access to the GPIO is possible, but no HAT boards can be used. Access to the CSI and DSI ports is tricky, but possible. The limitations of this cooler are that it's large, and so any case is rendered useless. If you are building a home server then this is the cooler to use, but you will need to be creative in how the Pi is stored.

SO WHICH IS COOLEST?

We took a reading at the start of the test (idle. At four minutes into the test, the Pi is confirming prime numbers and running at 100 per cent speed, which means it's working as hard as it can. See the graph below for the collected results.

As you can see, Pimoroni's Fan Shim – the lowest-priced option – is the most effective, offering dramatic cooling from a tiny fan but with no heatsink. A heatsink offers an extra level of thermal transfer and in terms of pure cooling, the 52Pi Ice Tower is a beast with a copper heat pipe and heatsink cooled with a powerful fan. When under full load (two minutes into the test) the CPU was reporting only 42°C, so compared to a stock Pi running at 57°C, we have a 15°C drop in temperature

But if we change the thermal pad on the CPU for thermal paste, we see a massive difference, with the CPU running at 29°C – almost a 50 per cent drop in temperature! The main problem with the 52 Pi Ice Tower is that it is massive. If we're using it in a home server capacity



Raspberry Pi 4 passive and active cooling results.

that might not be an issue, but we can't use this cooler for typical Pi projects. If we need to use the Pi for a 'normal' project then the Pimoroni Fan Shim is an excellent and very cheap solution. It is small, and when used in constantly active mode, it can match the 52Pi Ice Tower for cooling power.

So for what projects would the 52Pi Ice Tower be of use? Quite simply, overclocking your Pi from 1.5GHz to 2GHz – that's a 25 per cent increase in power for free. Overclocking is when the CPU is pushed past the recommended limits, and overclocking a Raspberry Pi is quite simple – but it should only be attempted if you are prepared to accept that you may damage or break your Pi. Don't attempt to overclock without active cooling! For our overclock we used the 52Pi Ice Tower and some Arctic Silver thermal paste.

To overclock a Raspberry Pi 4, first open a terminal and ensure that your software is up to date.

```
$ sudo apt update
$ sudo apt upgrade
```

The next step ensures that the firmware on your Pi 4 is up to date, as we need the latest version in order to overclock successfully.

```
$ sudo rpi-update
```

When done, reboot your Pi to ensure that changes are made correctly. To set the overclock for the Pi, open a terminal and type the following to edit a configuration file.

```
$ sudo nano /boot/config.txt
```

Using the arrow keys, scroll to the bottom of the file and create a new line, then enter the following to set the voltage and CPU speed.

```
over_voltage=4
arm_freq=2000
```

To save and exit nano, press Ctrl-x, and when asked to save, press Y and then Enter. Reboot the Pi for the overlock to take effect. When the Pi has rebooted, open a terminal and type the following to see the current CPU speed, which at idle is around 600MHz:

```
sudo watch cat /sys/devices/system/cpu/cpu0/cpufreq/cpuinfo_cur_freq
```

How can we push the Pi to use the new overclocked speed? Via a tool called Sysbench, we can instruct the Pi to confirm prime numbers from 2 upwards, so let's ask the Pi to confirm all of the prime numbers from 2 to 50,000. For this we shall use all four cores (threads) of the CPU to ensure that the Pi is maximised. In another terminal, type:

```
$ sysbench --test=cpu --cpu-max-prime=50000 --num-threads=4 run
```

Now watch the original terminal, which will update every two seconds to show the current CPU speed. Under load you shoule see the CPU speed shoot up to 2GHz – and hopefully stay there without crashing due to overheating.

Cooling your Raspberry Pi 4 may not be essential for day-to-day use, but for those that wish to push the silicon and get the most from their Pi, it is absolutely essential. As always, take great care when using cooling units with your Pi 4, ensure that they are fitted correctly and if they are made of metal, that they are not in contact with electronics or power circuitry. ■

Thermal Pads vs Thermal Paste

The 486 and early Pentium chips ushered in cooling, and the heat generated from a CPU needed to be removed as quickly as possible. Thermally conductive materials were required, and with this the thermal pad was factory-applied. We remember attaching the cooling to our first 1GHz AMD Athlon CPU and playing a game... but we forgot the thermal pad, and the CPU quickly cooked itself to death.

Thermal pads enabled anyone to simply place the cooling unit on the CPU and get on with building the PC. But if you need to pull more heat from a CPU, we can use a thermally conductive liquid: a paste. Thermal paste is available in many different combinations and various cooling claims, but typically it's cheap and offers better conductivity than a pad.

The problem is that thermal paste is a little tricky to apply if you're new to PC building. Just remember that a small blob goes a long way, as the paste spreads out when heated. On our Raspberry Pi 4 with the 52 Pi Ice Tower cooler we used a rather cheap Arctic Silver 5 compound, and applied a 5mm blob to the CPU. With that small amount we dropped the CPU temperature considerably.

The GeeekPi case is made from aluminium, but it requires further refinement to make it worthwhile. It's a little too low-cost to prove itself useful and safe for long-term projects.

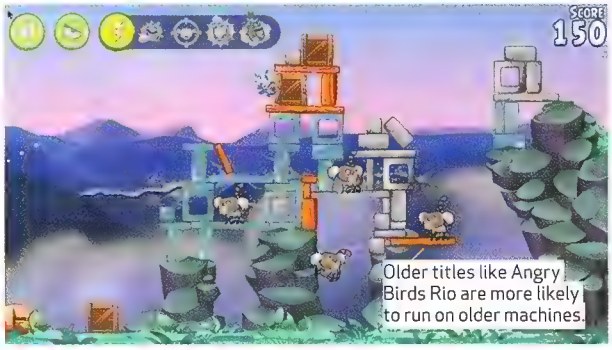
COOLER	IDLE	FULL LOAD FOR FOUR MINUTES	PRICE	WEBSITE
STOCK	39°C	65°C	N/A	WWW.RASPBERRYPI.ORG
CORE DUAL FAN HEATSINK	37°C	47°C	$25.95	TINYURL.COM/APC476CRE
FAN SHIM (CONSTANT)	29°C	45°C	$16.95	TINYURL.COM/APC476SHI
FAN SHIM (SOFTWARE-CONTROLLED FAN)	37°C	63°C	$16.95	HTTP://BIT.LY/LXF257SHIM
52 PI ICE TOWER	31°C	45°C	$39.95	TINYURL.COM/APC477PIT
GEEEKPI ALUMINIUM	37°C	56°C	$28	TINYURL.COM/APC477GPI
PIMORONI ALUMINIUM CASE (PASSIVE)	44°C	63°C	£12	HTTP://BIT.LY/LXF257PIMORONI

Get some (Android 9.0) Pie on your PC

Still waiting for Android 9.0/Pie to hit your phone? Try it on your old PC instead. Darren Yates explains how.

There's a pretty solid temptation to consider any PC or laptop that struggles to run the latest Windows operating system as having passed its use-by-date. However, that would needlessly remove the opportunity of putting to work one of the many Linux distros – and there are dozens of them now to choose from. While this usually means everything from Elementary OS to Debian or a lightweight homebrew based on an LXDE desktop, there's another Linux distro you can now add to the list – Android.

We've been keeping tabs on the Android-x86 effort since the early days of Ice Cream Sandwich/4.0. Now the first 'release candidate' of Android 9.0/Pie has arrived, we'll show you how to install it on an older system and give your old kit a new lease of life.



HOW OLD IS 'OLDER'?

If you think about it, Android is designed to generally run on hardware-constrained devices, like phones, tablets and TVs, so it doesn't need 8GB of RAM and 512GB of flash storage to run well. But when it comes to Android-x86 and support for older PC systems, just how old a system can you reasonably get away with using? I have an old Compaq Presario CQ42-136TU notebook I keep for such occasions – 1.9GHz Intel dual-core Celeron T3100 processor and 2GB of RAM. To be honest, I replaced it back in 2011 because it was slowing down and SSDs were still a rich man's game. However, sometime later, I replaced the 250GB hard drive with a spare 64GB SSD and I've actually been using it to run the various Android releases ever since. The CQ42 dates from 2010, so it's probably as old as you'd want to go back, at least for a laptop, but that makes it an ideal testbed to try with Android-x86 Pie.

If nothing else, we'd recommend your test system has at least a dual-core CPU.

HP's Compaq Presario CQ42 is 10-years old but runs well on Android 9.0.

SETTING UP A USB FLASH INSTALLER

Android-x86 9.0/Pie comes as an ISO image, which you'll need to setup on a USB flash drive to install onto your test system (Android-x86 has no support for CD/DVD drives). There are two versions – 32-bit and 64-bit. For more modern systems, the 64-bit version would be ideal. However, despite the Celeron T3100 having 64-bit support, we couldn't get the 64-bit version to fire up – install, yes; boot, no. However, the 32-bit version worked a treat. The 32-bit version is approximately 750MB, the 64-bit around 920MB. Any 2GB or larger USB flash drive will be fine for either version.

However, just remember – the setup procedure will wipe the current contents of the USB flash drive, while the install onto your PC system will erase the contents of the hard drive/SSD. So the tip is – backup before you start. Personally, there was another reason for replacing the hard drive with an SSD – not only is the SSD considerably faster, it allows me to keep the original drive in its existing condition, so that I can reinstall it if need be and get back my original laptop. Standard 120GB 2.5-inch SSDs, such as WD's Green drive, are as low as $32 online, so it shouldn't break the bank, but just check your laptop's

internal drive connections before you start. The other thing to remember is that Android-x86 9.0/Pie still left me with 55GB of space from a 64GB SSD, so a 128GB SSD will be complete luxury.

Grab the ISO image from **android-x86.org/releases/releasenote-9-0-rc1.html**.

INSTALLER SOFTWARE

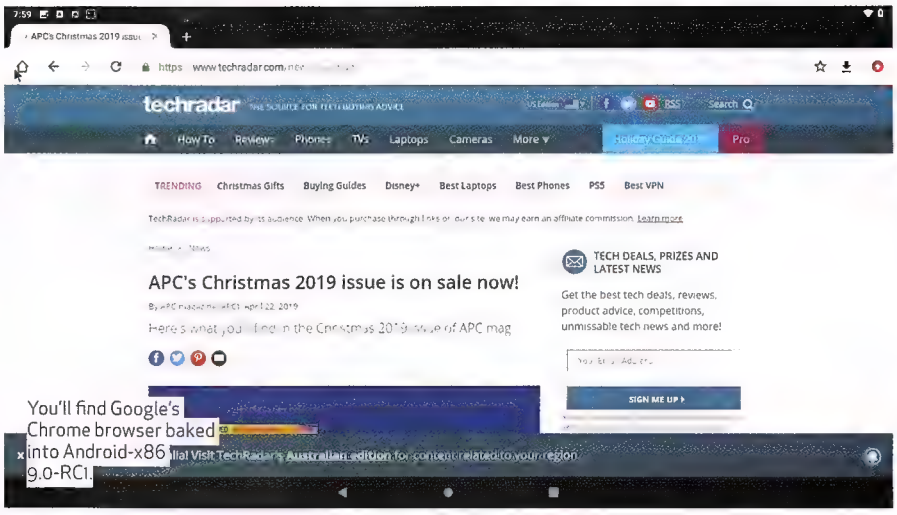
Once you have the ISO image, plus your flash drive plugged into your normal PC ready to go, find UNetbootin (**unetbootin.github.io**). It's easy to use and will combine the ISO image and your USB flash drive to create a ready-to-roll Live USB installer. Once you have UNetbootin, just run it (there's no app installer), select the radio button next to 'Diskimage' and press the ellipsis (...) button on the right. Browse to your ISO image location, select the ISO image and press 'Open' to complete the Load sequence.

Now make sure you set the 'Type' drop-down box to 'USB drive' and the correct drive letter for your USB flash drive. Otherwise, you might fry your PC's hard drive by mistake. When you're ready, press the 'OK' button on UNetbootin. This starts the unpacking process, copying files out of the ISO image and onto the USB flash drive.

The whole process should take no more than a few minutes. Once complete, remove the flash drive from your normal system and plug it into your old test PC/laptop.

BOOT FROM USB

Now at this point, you need to boot up your old test box into its BIOS to enable booting from the USB flash drive. The key sequence to get into the BIOS setup is different for every system, so check your user manual or just watch the boot screen for the keyboard shortcut that launches the boot menu. Select the USB flash drive as the default boot drive and reboot. Once it boots, you should see a text menu for Android-x86 with a few options – the two key entries are 'live CD' and 'installation'. The first aims to let you trial Android-x86 on your system without installing anything, but as soon as you turn off the system, anything you've done on it is lost. The second option is the one you want – install the Android OS onto your device's internal storage for 'persistent' use.



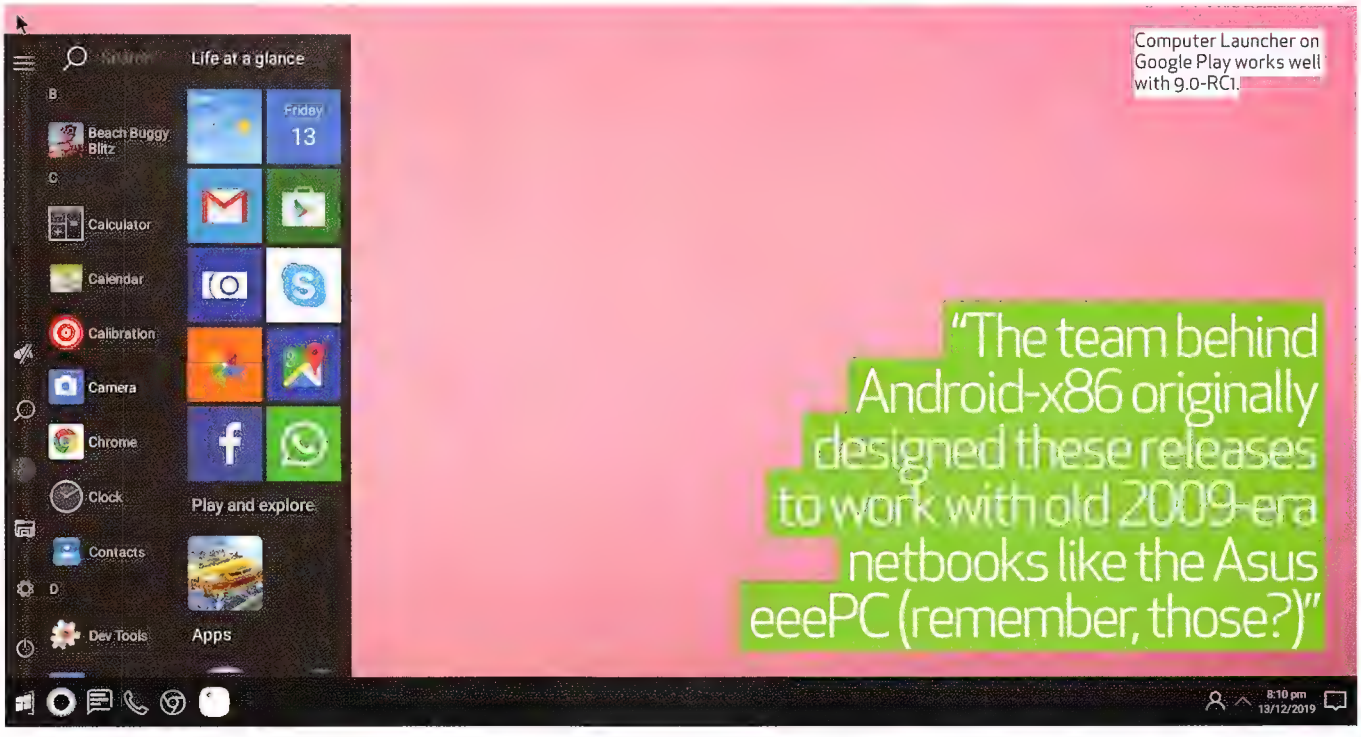
You'll find Google's Chrome browser baked into Android-x86 9.0-RC1.

The install process is much more streamlined in this version than in versions past. It'll recognise all the storage devices on your system – select the main internal storage and that's about it. The installer formats the internal storage, then unpacks the USB flash drive files and installs them onto the internal storage drive. Remember – everything on that internal system drive will be erased during this process. We found the install here pretty quick, too – the Presario CQ42 laptop had Android installed, up and running within five minutes.

WHAT WORKS, WHAT DOESN'T?

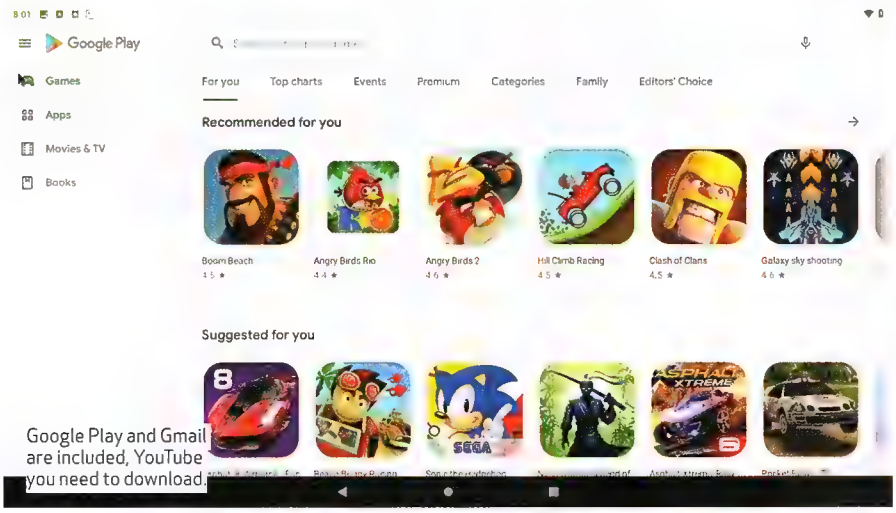
The team behind Android-x86 originally designed these releases to work with old 2009-era netbooks like the Asus eeePC (remember, those?), but according to the release notes, this new version should provide OpenGL ES3.x hardware video acceleration for Intel, AMD and Nvidia GPUs. We've only tried Intel-based laptops with this, so if you have an AMD laptop or PC, it'd be worth a shot if you have an old spare SSD to play with.

Now all that said, this is an 'RC-1'



Computer Launcher on Google Play works well with 9.0-RC1.

"The team behind Android-x86 originally designed these releases to work with old 2009-era netbooks like the Asus eeePC (remember, those?)"



Google Play and Gmail are included, YouTube you need to download.

Android recognises most of the PC hardware it's installed on

release, so it shouldn't surprise if not all the bells and whistles work as they should. However, the Presario CQ42 actually fared pretty well – native screen resolution (despite only low-end built-in GM45 graphics), Wi-Fi and sound working off the bat, enough graphics acceleration to at least get 'Beach Buggy Blitz' running at a reasonable clip and the built-in SD/MMC card reader also played nicely. The keyboard sound volume and screen brightness keys worked perfectly, as did the mouse trackpad. Even the built-in web camera on the screen top bezel fired up and showed images.

As we mentioned before, however, there's no joy from the CD/DVD optical drive. The other thing we noticed is that the Presario CQ42 didn't come out of hibernation too well – Wi-Fi stopped working and the notification pull-down gesture no longer worked, requiring a restart to kick back into life. Remember, it is an RC-1 release.

WHICH APPS WORK?

First off, the good news is the distro comes with Google Apps (Gmail, Google Play) built-in – just add in your Google account and away you go. As for security, at this point, I always play it safe and use a test Gmail account on these builds rather than the actual Gmail account on my phone. I've not heard any bad things about Android-x86 in terms of security leaks, but I tend to be a 'glass is one-tenth empty' kind-of person in this regard.

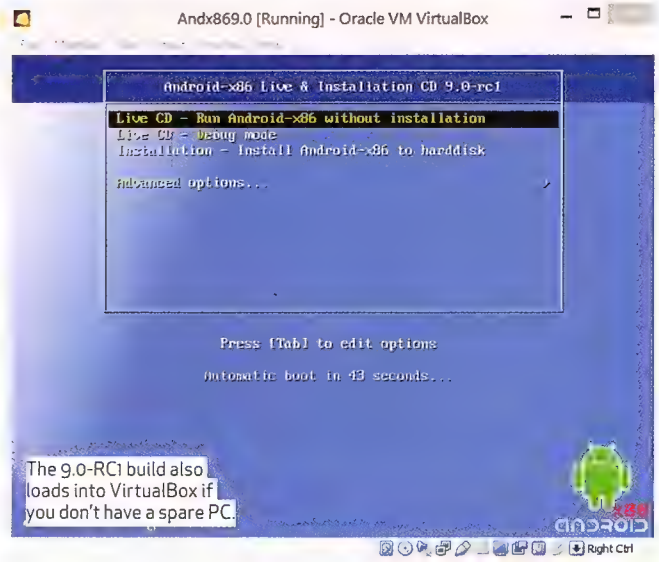
This x86-Pie distro also has root-access and the built-in Security Patch Level is August 2018, which isn't exactly current. These factors should guide you on how you use it.

The distro also has a screen-orientation lock – if you find yourself with activity screens that look more like an old 3.5-inch phone, activate the orientation lock (drag down from top of screen) and to see if it helps.

Now as for the apps themselves, with well over two million apps on Google Play, you won't be short of options. Google's Chrome browser is baked in as well – it starts and runs with no issues. Somewhat surprisingly, there's no YouTube app installed, but you can get this from the Google Play store easy enough. Alternatively, YouTube on the web browser works nicely, too. Either way, the Android-x86 OS runs natively on PC hardware, so you should be able to extract whatever performance your hardware has to offer. The YouTube app for instance delivered 720p resolution video on the Presario CQ42 laptop just fine (the screen is only 1366x768-pixels native, so that's good enough).

GAMING

There's a reason we tried 'Beach Buggy Blitz' – frankly, with only Intel GM45 graphics to play with, any game more serious than that is going to struggle on the Presario CQ42. Angry Birds Rio


Andx869.0 [Running] - Oracle VM VirtualBox
Android-x86 Live & Installation CD 9.0-rc1
Live CD - Run Android-x86 without installation
Live CD - Debug mode
Installation - Install Android-x86 to harddisk
Advanced options...
Press [Tab] to edit options
Automatic boot in 43 seconds...
Right Ctrl

The 9.0-RC1 build also loads into VirtualBox if you don't have a spare PC.

Creating your USB flash installer is easy with UNetbootin.

also worked well, but again, your mileage will vary, for sure – the performance you get will be a mix of the RAM, CPU and GPU you have to throw at games. The Android-x86 Pie distro does offer software rendering through Google's SwiftShader APIs for GPUs that aren't supported. However, remember that software rendering is going to depend on how much CPU horsepower your device has to spare.

In general, most games are not designed for x86-based CPUs, so the more GPU-enhanced games are likely to crash-on-load a lot more. We can't give you a definitive working list, since it'll be hardware-dependent, but plenty of games we tried still crashed on our CQ42. Games that support keyboards will also be important here.

AUDIO/VIDEO

Video playback and recording works on your Android phone because it doesn't rely on your device's CPU cores. Rather, most SoC (System on a Chip) chips have dedicated hardware video compression baked in to do the heavy lifting. Most older x86 chips, however, rely on GPU-acceleration for this, so again, your mileage will vary. VLC and MX Player apps from Google Play will give you codec support for just about everything, but I'd suggest from experience a dual-core CPU will struggle to decode video resolution at full frame rate beyond 720p, so you'd want quad-core for 1080p or 4K video playback.

USB-OTG

Android does pretty well with USB On The Go (OTG) support these days and Android-x86 in particular is ready to go, so you should find some fun with your system's USB ports. As a quick test, we had USB flash storage working for file copy and backup, we also had USB audio (a cheap CM102 USB headphone/mic dongle) working via YouTube. That augurs well for other USB devices that conform to the USB device standards support generally by Android. Just remember you'll need to find apps that support USB devices to get any real joy and don't forget the power limits those USB ports will have when you start plugging things in.

BATTERY LIFE

Speaking of power, Android handles overall power management and sees the battery capacity in percentage, which is always a good thing. While CPU-Z couldn't find the scaling governor being used to throttle the CPU, overall battery life appeared to be equivalent to the original Windows 7 level on the CQ42. After 40 minutes, the battery had dropped to 79%, call it 80% - that extrapolates out to three hours 20 mins, which is roughly what I'd expect from a 10-year old Lithium-ion battery that's had little work recently (it didn't last much more than that brand-new).

Hold the power button down and you get a slide-out panel on the right-side of the screen with shut-down, reboot and sleep options – and they generally work well. Android 9 also gives you a user-settable battery saver mode to give it a hand.

WHY ANDROID-X86 IS WORTH A LOOK

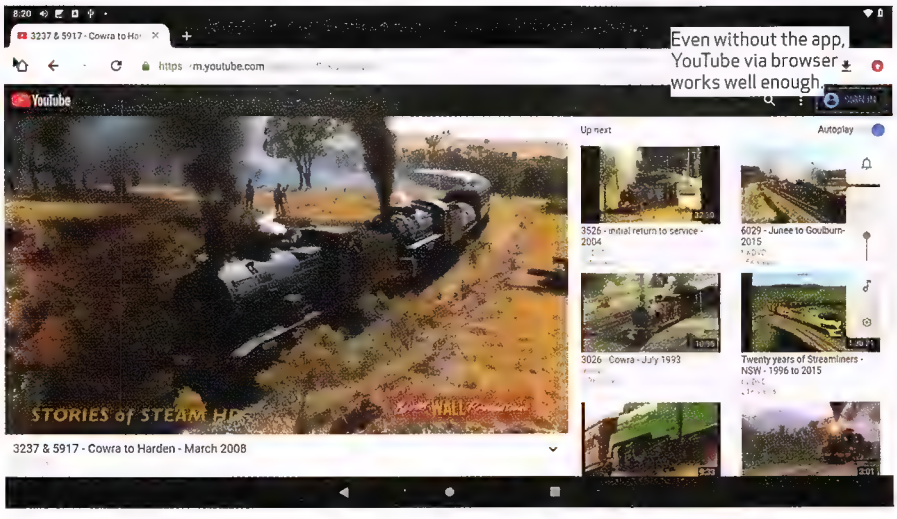
The Presario CQ42 came out with Windows 7, which has just gone 'belly up' as far as security updates go, with Microsoft finally nailing the coffin shut on January 14. However, I wouldn't bother installing Windows 8, let alone Windows 10 on this thing, with just 2GB of RAM. Sure, RAM is cheap these days, but a ten-year-old dual-core Celeron is still a ten-year old dual-core Celeron, no matter how much RAM you throw at it. The point is Android-x86 is designed for lighter-weight hardware and works rather well on ten-year old PC hardware. In fact, anecdotally, I'd say a 2GHz Celeron dual-core CPU is probably somewhere near the same postcode as a quad-core 1.3GHz ARM Cortex A53 SoC for general app performance, so it's not a bad match really.

If you want a genuine desktop experience, I'd probably go with a lighter-weight Linux desktop instead, something with an Xfce environment would do nicely. However, with the best part of three million apps available, Android is a worthwhile OS option to have in your kit-bag.

What's more, you're more likely to see Android 9.0/Pie on your old laptop before getting any Pie updates on many recent phones – so that's something to think about.

> "I always play it safe and use a test Gmail account on these builds rather than the actual Gmail account on my phone."

This waveform generator turns the sound card into an audio signal generator.



Even without the app, YouTube via browser works well enough.

Push live system stats to the cloud

Les Pounder shows us how to create a Telegram bot that will show updates from a Raspberry Pi server and broadcast them to the world.

Telegram is an encrypted, private messaging service with an open API that is really easy to use. In this tutorial we shall build a Telegram Bot, code that reacts to commands issued by the user from inside Telegram. Our bot will give us the latest CPU temperature, CPU usage and current available RAM for a Raspberry Pi.

SOFTWARE SETUP

Before any code can be written, we first need to sign up for a Telegram account. There are many clients for Windows, Linux and mobile devices. For this tutorial it would be prudent to install the desktop client, but if you are completing the tutorial on a Pi, you can use the web version. With the account created and Telegram installed we can now start to create a bot that will react to messages. To do this we need to use The BotFather, an automated script that handles the creation and maintenance of Telegram bots. Open a browser to **https://Telegram.me/botfather** and then tell The BotFather that we wish to create a new bot.

```
/newbot
```

Follow the automated instructions and after a short while your new bot will be created. The BotFather will provide a URL to start our bot, and an API key. Copy the API key somewhere safe – we'll need this later. Click the link to start a conversation with your new bot. You'll see a start button at the bottom of the screen – click this to start the bot. That is all that we need to do in Telegram for now, but we will come back to it later.

On our Raspberry Pi we now need to install the Python library for this tutorial. Open a terminal and type

```
$ sudo pip3 install pyTelegramBotAPI
```

Close the terminal when complete.

CODING THE PROJECT

Open your preferred Python editor (IDLE, Thonny, Mu or similar) and create a new file. Save the file as TelegramBot.py and remember to save often.

We start the code for this project by first importing libraries that will provide the functionality in our application. The first is the 'telegram' library for Python, then we import 'time' to control the pace of the code. Finally we import a library to enable Python to investigate system resources.

```
import telebot
import time
import psutil
```

You need

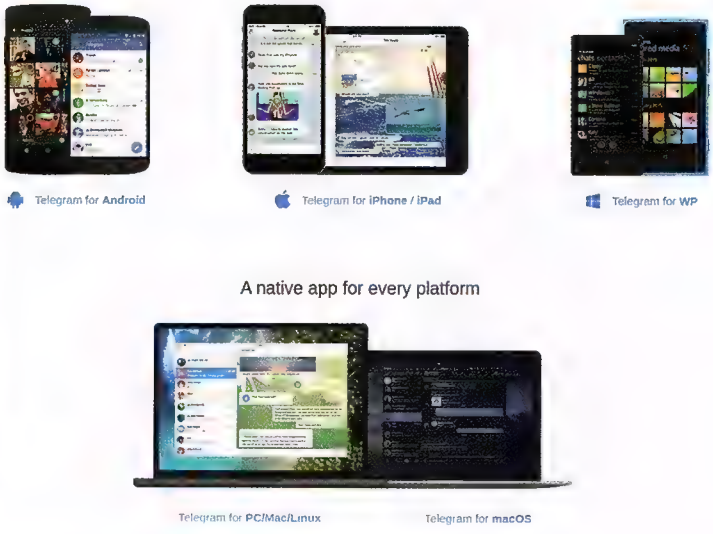
- Any model of Raspberry Pi
- A desktop/ laptop/mobile
- Internet connection
- Breadboard
- 2x 330 Ohm resistors (Orange, Orange, Brown, Gold)
- 1x LED
- 2x female-to-male jumper wires
- Code: **http://bit.ly/lxf256telegram**

The next step is to create an object that will provide a link for our code to the Telegram bot. This is handled via the API key, unique to our bot. The object `tb` creates the link.

```
tb = telebot.TeleBot("Your API KEY HERE")
```

With a connection to Telegram created, we now create a handler that will react to a specific message from the user. The message is `/stats` and in order for it to be identified by the code we need to create a test. The test is in a function that will check the contents of the message (`msg.text`) to ensure that it is not blank, and that it contains the `/stats` command.

```
@tb.message_
```



Telegram is available on just about every platform you can think of.

```
handler(func=lambda msg: msg.
text is not None and '/stats'
in msg.text)
```

Next is the creation of a function, `send_welcome` , that will trigger the start of a flurry of activity. First a variable `temperature` is created and in there we store the output of the command to read all of the sensors on the Pi. But the output from this command is quite densely packed, so on the next line we update the contents of the variable so that it targets only the CPU temperature sensor. For the final step we convert the returned variable into a list, so that the contents can be easily selected.

```
  def send_welcome(message):
      temperature = psutil.
sensors_temperatures()
      temperature =
(temperature['cpu-thermal']
[0])
      temperature =
list(temperature)
```

As well as showing the CPU temp, we also want to show the CPU usage as a percentage, and the amount of free RAM available. It's just one line of code to get the CPU usage and store it in a variable called `cpu` . But for the memory we first need to save all of the memory information to a variable called `memory` and then extract the current available memory, which is stored in a list with an index of 1. This makes it the second item in the list. Then we use some maths to convert bytes to megabytes and the `round()` command to produce an easily readable value.

```
      cpu = psutil.cpu_
percent(interval=1)
      memory = psutil.
virtual_memory()
      memory = memory[1]
      memory = round(memory /
1024 / 1024)
```

Still inside the function, the next three lines handle replying to the user with the details of the server. First will be the CPU temperature. Using the `tb.reply_to` function we reply to the original message via a string. The string contains a sentence that will tell the user what the data is, and inserted into that sentence is the contents of the list `temperature` that we created earlier. But we only need a specific piece of information which is stored in index 1 of the list – this is the CPU temperature in Celsius. At the end of the sentence we add the letter 'C' to identify that we are using the Celsius temperature scale.

```
      tb.reply_to(message,
'CPU Temperature is
'+str(temperature[1])+'C')
```

The next two lines provide the data for the CPU usage and the amount of free memory. They work in a simpler manner to the temperature line.

```
      tb.reply_to(message,
'CPU Usage is '+str(cpu)+'%')
      tb.reply_to(message,
'Free RAM is
'+str(memory)+'MB')
```

This is the end of the function and we now move on to the final section of code, which is a loop to continually check Telegram for updates (`polling`) and to handle any error messages and the user exiting the code. Using exception handling we first try polling Telegram, but if the user requests to exit, an exception is raised and the code will end. Another exception is when an error is raised; this typically happens after an hour of use. If so, the code will pause for 15 seconds before the loop repeats.

```
  while True:
      try:
          tb.polling()
      except
KeyboardInterrupt:
          print("EXIT")
          break
      except Exception:
          time.sleep(15)
```

The code is now complete and is ready to run. Start the code and then go to the Telegram application and send the `/stats` message to your bot. This will trigger the bot code to run and give us live stats from our Pi. It's as easy as that! ■

Control the GPIO

In the tutorial we created a function that would react to a command from the user and post data to Telegram. We can also use Telegram to control the GPIO of a Raspberry Pi.

The code remains very similar to the tutorial code, but we use the GPIO Zero library and import the LED class, then we set GPIO 17 as the pin for our LED.

```
  from gpiozero import LED
  led = LED(17)
```

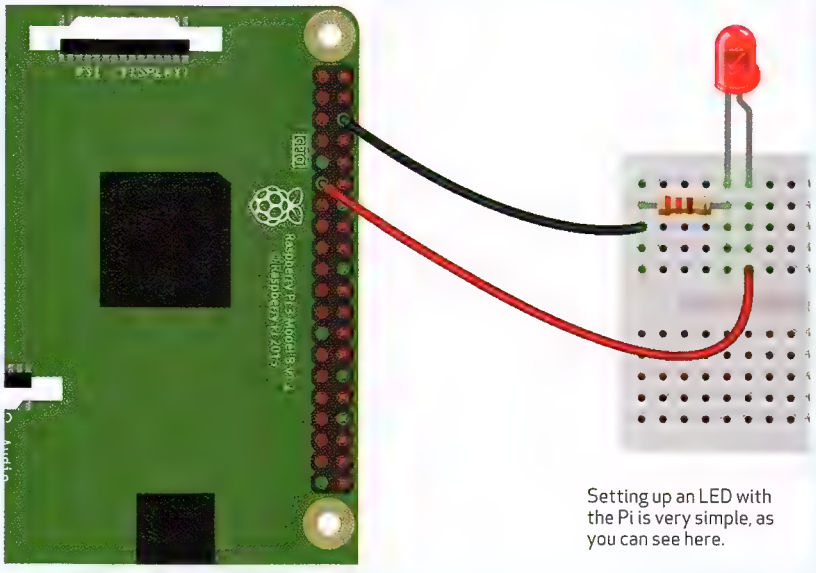
We then change the message handler to look for `/led-on` . If that command is issued it runs the GPIO Zero code to turn on the LED.

```
  @tb.message_handler(func=lambda msg: msg.text is not None
and '/led-on' in msg.text)
  def send_welcome(message):
      tb.reply_to(message, 'LED On')
      led.on()
```

The code to turn off the LED is very similar to turning it on.

```
  @tb.message_handler(func=lambda msg: msg.text is not None
and '/led-off' in msg.text)
  def send_welcome(message):
      tb.reply_to(message, 'LED Off')
      led.off()
```

Run the code and you can control an LED over Telegram! We've made a video demonstrating, for more go see this: **http://bit.ly/lxf256telegram2**



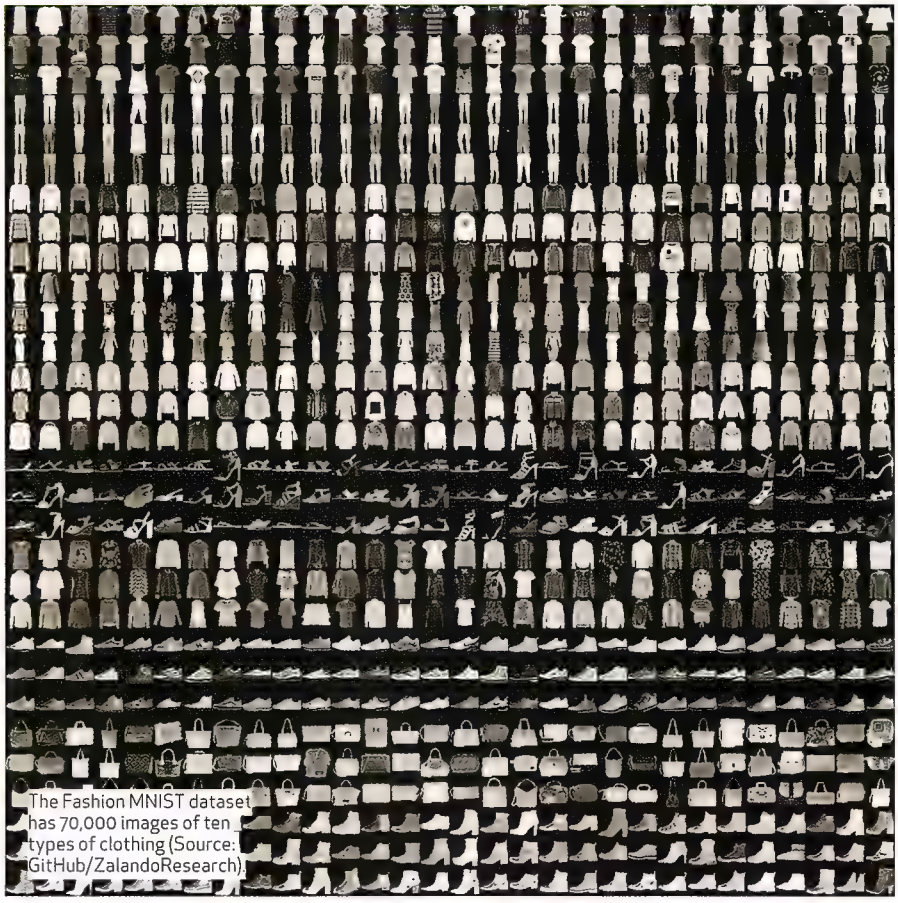
Setting up an LED with the Pi is very simple, as you can see here.

TensorFlow 101

Google's TensorFlow is making waves in a wide range of applications – but what actually is it and how do you use it? Darren Yates writes this simple guide.

It's a pretty exciting time to get involved in machine-learning. While there's certainly way too much hype surrounding it for my liking, there are many practical applications where it's making a real difference. Health and agriculture, bushfire management and prediction, even protecting wildlife and endangered species are all seeing machine-learning applied in real value ways. It's even finished Beethoven's *Tenth Symphony*.

This boom in application has come from a rapid increase in open-source machine-learning tools and cloud computing. All the big tech brands now have ML tools, many are even open-source. One of the major players is Google's TensorFlow. This month, we'll take a brief tour of what TensorFlow is and does, and how to use it on your PC.



The Fashion MNIST dataset has 70,000 images of ten types of clothing (Source: GitHub/ZalandoResearch).

WHAT'S A TENSOR?

ML is predominantly about mathematics, but don't' let that freak you out - we'll keep things broad enough not to scare you off, but deep enough to give some understanding. Take a spreadsheet in Excel – it has rows and columns of individual cells. In mathematics, a single cell's value is a 'scalar'. Programmers represent a row of a spreadsheet as an 'array' of numbers and mathematicians call this a 'vector'. So, a spreadsheet is a collection of vectors. Again, mathematicians call this two-dimensional (2D) collection of vectors a 'matrix'.

A tensor can act like these 'data structures' – for example, a scalar, a vector and a matrix are zero-, one- and two-dimensional tensors, respectively, but you can extend this to higher dimensions and this is where tensors really start to fly. In tensor-speak, the dimension of the tensor is referred to as its 'rank', so a matrix is a rank-two tensor.

However, a tensor is not only a generalised data structure, it also supports different mathematical transformations of its data and this makes tensors ideal for a particular style of machine-learning known as 'deep learning'.

NEURAL NETWORKS

When you hear mention of 'deep learning', what's actually being described is usually some form of 'neural network', which are algorithms that loosely follow how the brain works, with neurons connected together that allow data to flow between them.

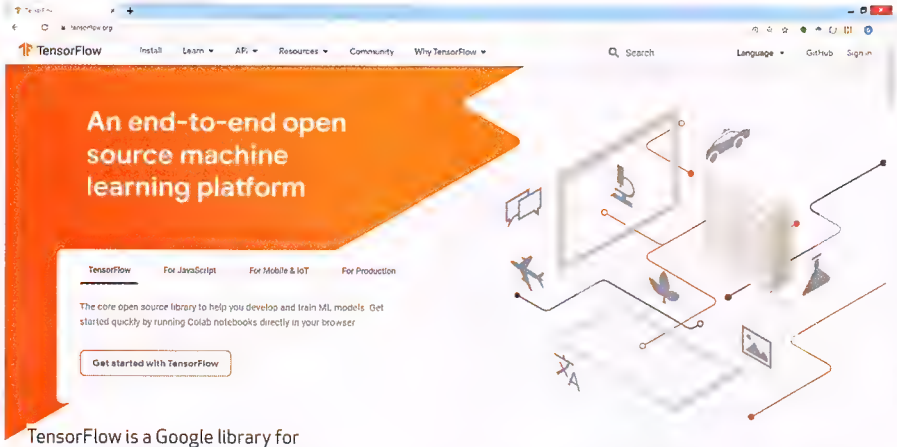
The deep-learning model predicts the clothing type with 90% accuracy.

We don't have space to cover them all here but there are numerous categories of neural networks, including recurrent neural networks (RNNs) and convolutional neural networks (CNNs). RNNs are often used in natural language processing (think chatbots, for example), while CNNs often appear in image processing applications, where you're trying to detect objects.

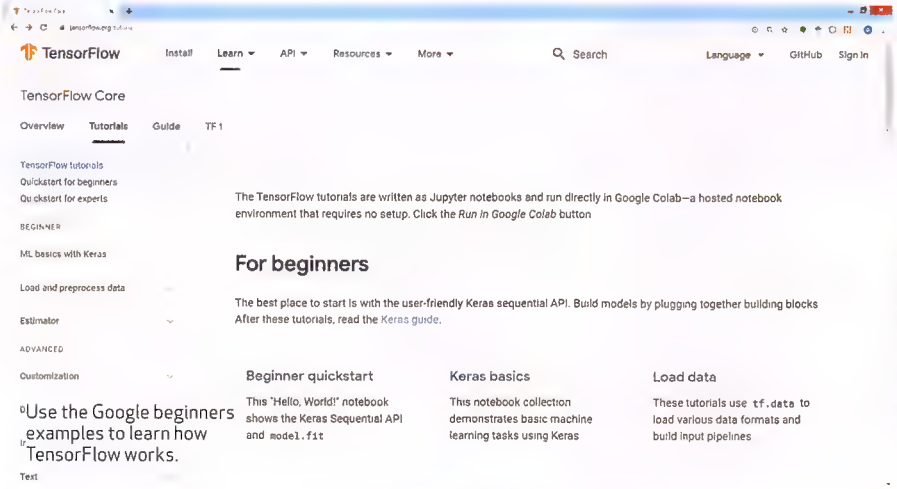
In the right application and with lots of data, neural networks are great – but in spite of overwhelming hype, they're not perfect. In most cases, it's difficult to understand why NNs react to specific data because essentially, they act as a 'black box' where you can't see what's going on inside. They typically need more data and take longer to build than traditional machine-learning types such as decision trees and forests. Don't get me wrong – I'm not against NNs, but I am equally not a fan of treating neural networks like a shiny new hammer and every machine-learning problem as a nail to be hit with it.

TENSORFLOW

With that as a background, Google's TensorFlow is a machine-learning library that's designed to make the many tensor calculations faster and easier to



TensorFlow is a Google library for faster execution of deep learning.


TensorFlow
Install
Learn
API
Resources
More
Search
Language
GitHub
Sign In
TensorFlow Core
Overview
Tutorials
Guide
TF 1
TensorFlow tutorials
Quickstart for beginners
Quickstart for experts
BEGINNER
ML basics with Keras
Load and preprocess data
Estimator
ADVANCED
Customization
Text
The TensorFlow tutorials are written as Jupyter notebooks and run directly in Google Colab—a hosted notebook environment that requires no setup. Click the Run in Google Colab button
For beginners
The best place to start is with the user-friendly Keras sequential API. Build models by plugging together building blocks. After these tutorials, read the Keras guide.
Beginner quickstart
This "Hello, World!" notebook shows the Keras Sequential API and model.fit
Keras basics
This notebook collection demonstrates basic machine learning tasks using Keras
Load data
These tutorials use tf.data to load various data formats and build input pipelines

Use the Google beginners examples to learn how TensorFlow works.

Google's Colab notebooks run ML code examples in your browser.

The model can predict the type of fashion image to one of 10 classes.

> "When you hear mention of 'deep learning' what's actually being described is usually some form of 'neural network', which are algorithms that loosely follow how the brain works."

work with. What's more, its open-source and you can use it with the Python programming language.

Google has a decent tutorial and beginners guide on its **tensorflow.org/overview** website and it's well worth a look. You can even run the examples online at Google's 'Colaboratory' using just your browser. For simplicity's sake, that's what we'll do.

FASHION EXAMPLE

First thing, head over to **http://tensorflow.org/tutorials** and click on the 'Keras basics' tile in the 'For beginners' area. Keras is a neural network library that runs in Python and makes use of TensorFlow to handle data processing – but we'll be using it in a browser.

This example is a classification task that learns how to identify different images of clothing, from shoes to tops and bags. Click on the 'Run in Google Colab' button and this will bring up the tutorial in an online notebook you can run through your browser. At the top-left of the new window, you'll see a basic menu – File, Edit etc. On the right, you'll either see a 'CONNECT' button or a green tick next to RAM and Disk gauges. If you don't have the latter, click the Connect button. Once it's sorted, you can now run the example's source code by selecting from the top-left menu, 'Runtime' and 'Run all'.

The cool thing about this example is you can read through the description and see the code execute as you go. The first step it executes is installing the Fashion MNIST dataset, which contains 70,000 images, each 28x28-pixels, of various items of clothing. These images are grouped or 'classed' by type, with each belong to one of 10 classifications – T-shirt, trousers, pullover, dress, coat, sandal, shirt, sneaker, bag and ankle-boot.

After that, it'll preprocess the images – that means get them into a form that the Keras library can understand.

The next step is building the model – this is where the deep learning takes place, finding the patterns within images that categorises a coat from a bag, or sandal from trousers, for example. Once the model is built, it's then tested for accuracy – if you scroll down you should see that the test accuracy is around 88.3%.

Finally, the model is used to make predictions on unclassified images. You'll see the images are shown in pairs – the original clothing item and a chart which shows the predicted clothing type it is. Note that the predictions are not always definitive, or predicted with no uncertainty. For example, the model can struggle to choose between a shirt and a top (which is understandable – I do too from tiny 28x28-pixel images).

If you got this far, congrats – you've built your first deep learning model.

LEARNING THE FUTURE

Even better, you can change the code in the notebook, re-run it and see what happens – there is no better way to learning than rolling up your sleeves, trying things, making mistakes and learning from those mistakes. Just remember Deep Learning is only one way to perform this classification task and there are many others well worth trying.

The sheer breadth of application areas machine-learning has is just mind-blowing. Deep learning won't be ideal for every application, but that's why Australia needs more people who understand machine-learning. The opportunities are immense.

down

WHAT'S HAPPENING IN THE WORLD OF FUN, WITH SHAUN PRESCOTT.

A Star Wars Jedi Fallen Order sequel could be happening, new job listings suggest

Respawn is already hiring for its next project set in the Star Wars universe.

A sequel to *Star Wars Jedi: Fallen Order* could already be in the works at Respawn Entertainment, with three new job listings on the developer's website confirming that the *Apex Legends* studio is creating a new game set in a universe far, far away...

Three postings for a Senior Character Artist, Level Designer, and Senior Software Engineer reveal that Respawn's "Star Wars team" is working on a "third person action/adventure game", a description which fits the same genre that *Star Wars Jedi: Fallen Order* comfortably sits in.

While the vacancies don't outright confirm that this new project is a direct sequel to Respawn's recently released Star Wars title, it wouldn't be a surprise if such a thing has already been greenlit. The game broke sales records for publisher Electronic Arts, while Respawn Brand Strategy Director Charlie Houser recently told *GamesRadar* that the team would love to continue the story of Cal Kestis if it got the chance.

EA itself holds Disney's Star Wars license for at least another four more years, with the possibility of the contract being renewed at a later date.

Xbox Series X isn't the only next-gen Xbox, and it's not the only name

THINGS ARE GETTING COMPLICATED OVER AT MICROSOFT TOWERS.

It turns out that the Xbox Series X is only one of Microsoft's next-gen consoles, and we've been using the name wrong.

Microsoft's next-gen Xbox Series X console was announced last December at The Game Awards, complete with vertical monolith design. And, to be honest, we're only just getting used to the idea that the next generation of Microsoft consoles is called the Xbox Series X, but now it seems that the Xbox Series X is just one of Microsoft next-gen consoles. Instead, the tech giant's next series of consoles is technically just called Xbox.

According to a Microsoft representative, we've got it all wrong.

"The name we're carrying forward to the next generation is simply Xbox," said the Microsoft representative to Business Insider. "And at The Game Awards you saw that name come to life through the Xbox Series X."

"Similar to what fans have seen with previous generations, the name 'Xbox Series X' allows room for additional consoles in the future," the Microsoft rep told us.

Well. There you go.

The Witcher 3 breaks 100K concurrent players on Steam for the first time

The 2015 RPG is in the midst of a remarkable resurgence.

Early in January there were more people simultaneously playing *The Witcher 3: Wild Hunt* than were playing it when it first released – which, in case you'd forgotten, was all the way back in 2015. And it's not as if it slouched out the door back then, either: According to Steam Charts, its peak concurrent player count in May 2015 was an impressive 92,268.

This sudden resurgence in popularity is almost certainly attributable to the success of *The Witcher* on Netflix, and curiosity about the game has been easy to indulge thanks to ridiculously good sale prices on *The Witcher 3* on Steam and GOG, and free time to sink into it over the holidays (the fact that it's an outstanding RPG is probably a factor too). Those numbers will inevitably decline; even if all the newcomers play it from start to finish, an aged singleplayer RPG isn't going to maintain a player base the way a free-to-play game in active development will.

The race is on to launch the first gaming laptop with a 300Hz IPS display

ACER, ASUS, AND MSI ARE EACH PLANNING TO LAUNCH LAPTOPS WITH A 300HZ REFRESH RATE FOR FAST-ACTION GAMEPLAY.

At CES Acer and Asus are once again teasing gaming laptops with displays supporting ultra-fast refresh rates of up to 300Hz. There's still no word on which machine will be available to buy first, but it's no longer a two-horse race – MSI is saddling up a 300Hz stallion of its own.

We first heard about these laptops with speedy refresh rates back in September. Had things stayed on schedule, Asus would have launched its Zephyrus S GX701 in October, followed by Acer pushing out a Triton 500 laptop with a 300Hz panel in November. So, where are they? As things stand, neither machine seems to have been scrapped. It remains to be seen whether or not the Zephyrus S GX701 with a 300Hz panel will ever appear, but in Las Vegas Asus showed off its ROG Strix Scar III.

Asus is pitching this as the "world's fastest 300Hz/3ms gaming laptop display". It's the kind of thing that could find in audience among pro gamers participating in esport tournaments.

Just 3 months after it launched in Early Access, PlanetSide Arena is closing down

"WE REMAIN DEEPLY COMMITTED TO THIS FRANCHISE"

PlanetSide Arena only released in Early Access on September 19, 2019, but Daybreak Games has already decided it's time to pull the plug on the ambitious sci-fi arena shooter, stating low player numbers "make it impossible to sustain the gameplay experience we envisioned". The servers closed down permanently on January 10, 2020.

The Outer Worlds is getting story DLC in 2020

***THE OUTER WORLDS* IS GETTING MORE STORY CONTENT IN ITS FIRST DLC PACK, COMING IN 2020, OBSIDIAN HAS ANNOUNCED.**

We don't currently know details about *The Outer Worlds*' first DLC pack other than that it'll focus on "expanding the story." Obsidian revealed the news on their official forums in a post thanking *The Outer Worlds* community for their support and votes during The Game Awards 2019. *The Outer Worlds* was nominated for Best Narrative, Best Performance for Ashly Burch, Best RPG, and Game of the Year awards.

There's a console inside this PC

ORIGIN PC IS READY TO GIVE PLATFORM-AGNOSTIC GAMERS THE BIG O.

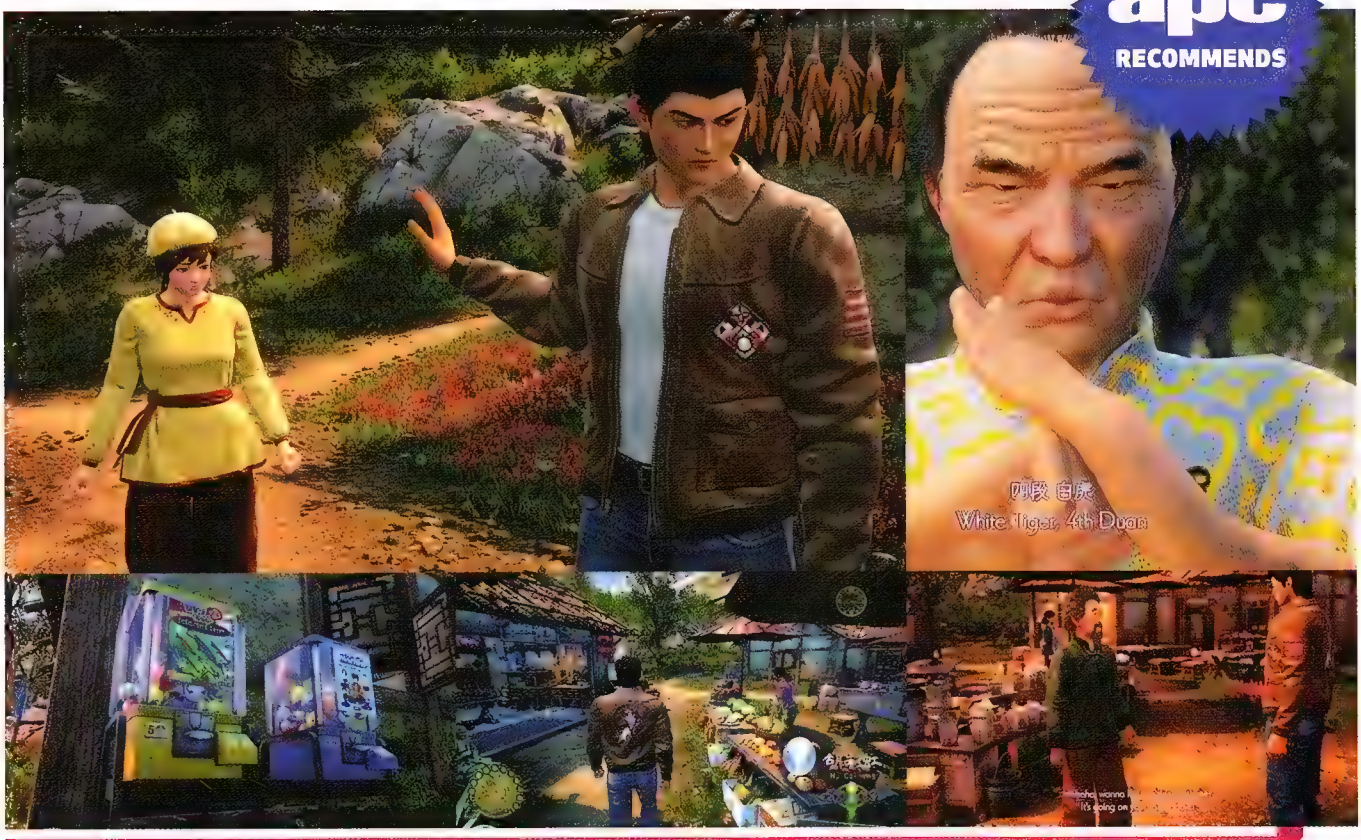
While not the first attempt at this, Origin PC has announced its 'Big O' PC, which comes with either Xbox One or PS4 components built in. What Origin PC is basically doing is gutting PS4 Pro and Xbox One S consoles and injecting the main components inside the Big O. In other words, you're getting everything bar the console chassis.

New Top Steam Game: CS:GO player counts have officially overtaken Dota 2

THOUGH STILL INCREDIBLY POPULAR, *DOTA 2*'S NUMBERS ARE ON THE DECLINE.

Counter-Strike: Global Offensive has now reliably pushed past *Dota 2*'s peak and average player counts, making the shooter the more popular of Valve's big online games and the top game on Steam. For December 2019, *CS:GO* posted peak users of 767,000 while *Dota 2* reached nearly 628,000. *Dota 2*'s average player counts are the lowest they've been since 2014, when it was still a relatively new and growing game.

apc RECOMMENDS



$69 | PC, PS4 | SHENMUE.LINK

Shenmue 3

As flawed as it is wonderful.

Nestled in the mist-shrouded mountains of rural China, Bailu Village is a settlement frozen in time. People live slow lives here among rice paddies, ornate Buddhist temples, quaint cottages, and fields of colourful wildflowers. There are some clues that *Shenmue 3* is set in the 1980s, but otherwise life here has changed very little in the past hundred years.

It's an ideal setting for a Shenmue game, a series famous (or perhaps infamous) for its languid, aggressively deliberate pacing. This is a game as slow and meandering as the old man strolling through Bailu's marketplace deciding which kind of steamed bun to have for lunch.

This unlikely sequel sticks so closely to the formula of the first two games that it's almost as if the last 18 years of game design never happened. And honestly, as a fan, I couldn't be happier. From its earliest days the Shenmue series has been divisive, with opinion rarely falling in the middle. You either think it's an emotional, groundbreaking masterpiece or an indulgent, clunky mess. There's no in-between.

"This is a game as slow and meandering as the old man strolling through Bailu's marketplace deciding which kind of steamed bun to have for lunch."

It's been 18 years since *Shenmue 2* was released, but the third game picks up immediately where it left off. Japanese teenager Ryo Hazuki is desperately searching for the man who killed his father, a journey that has taken him from his hometown of Yokosuka to this mountain village. Central to Shenmue's plot are a pair of ancient artefacts, the Phoenix Mirror and the Dragon Mirror, which are deeply connected to both Bailu and the murder of Ryo's father.

Shenmue is, essentially, a detective game. You spend the majority of your time talking to people, asking questions, finding clues, and pulling on threads until the next piece of the puzzle reveals itself. Occasionally things turn violent and Ryo is forced to fight, either through QTEs or combo-based martial arts combat. But mostly it's just walking and talking, with some life simulation thrown in for good measure. You can chop wood or drive forklifts to earn money, eat food to restore stamina, or train at dojos to level up your skills.

Take a stroll through the wildflowers and pick some herbs. Shoot the breeze at the bridge leading into the village. Work on your capsule toy collection. Tell Shenhua about growing up in Japan. In an increasingly loud and relentless world, *Shenmue 3* is an ocean of calm. Step back into 1980s China and just go with the flow. That's when that curious, hard to define Shenmue magic emerges and you find yourself entranced by it. ■ **Andy Kelly**

Verdict

A seamless continuation of the series that makes up for its limitations with pure heart.

★★★★½

apc RECOMMENDS

$40 | PC, PS4, SWITCH | DRAGONQUEST.SQUARE-ENIX-GAMES.COM

Dragon Quest Builder 2

Lighthearted frolics hide a deep RPG.

Dragon Quest Builders 2 is as weird as it is delightful – and a very different beast to the main series.

The world needs saving and there are goofy Slimes to bash, but here you're more *Bob the Builder* than dashing swordsman. This quirky offshoot sees you go from building basic bedrooms and kitchens to help people survive in dire times, to constructing elaborate castles and giant magical trees, all in the name of defeating the evil Children of Hargon.

After inheriting a deserted island from a hairy mole-thing with a hammer and befriending a chap that likes hitting things a little too much you start about your task of creating your own kingdom. But you'll need more people and resources to do that, so off you pop to different islands, solving the issues there before returning with everything you've learned and plenty of materials.

The game is mostly split into two halves: your time on the Isle of Awakening when you can do whatever you want, be that creating cities, sculpting blocky statues in your own image,

or, in my case, building a multiplex of bathrooms, and your time investigating other islands where you'll help people out with quests and more specific builds.It's a great mix of freebuilding with just enough direction to help you make some impressive-looking stuff.

My one complaint is that the pacing gets a little odd sometimes. About halfway through you'll reach a section that you're stuck on until you complete it – no being able to switch to the freebuilding of the Isle Of Awakening or accessing the multiplayer.

Calling *Dragon Quest Builders 2* a Minecraft clone is a disservice. Yes, they're both block-based building games, but *DQB2*'s story gives all of your building purpose. By having so many individual items, *DQB2* feels way more polished. It's also easier to make something that looks good even if you don't feel creative.

■ Daniella Lucas

Verdict

Lighthearted with plenty of opportunities for creative building and a surprisingly solid story.

★★★★☆

Grimm's Hollow

It's not so grim being a reaper.

FREE | PC | GHOSTHUM. ITCH.IO/GRIMMS-HOLLOW

Finally, an *Undertale*-style RPG where you can really make the most of the combat system – without feeling awful about every enemy you kill. It begins with a girl named Lavender waking up in the afterlife. It turns out there's a purgatory, and it's full of violent ghosts, but also reapers to dispatch them to the Great Beyond. Upon death, Lavender is designated as a reaper, while her similarly deceased little brother becomes a ghost.

Borrowing the best bits from classic JRPGs, there's a *Final Fantasy*-style ATB system (turn-based meets real-time combat), partnered with the quick-time flourishes from the forgotten *Shadow Hearts*. After every melee attack, you'll be asked to hit the down key on a Golf-style swing-o-meter. Do it right, and you'll inflict more damage. But hit too early, or wait too long, and your attack will whiff.

The Hollow's three dungeons are pretty enjoyable to explore, as you hunt secret doors and fight ghosts to an absolute banger of a battle theme. It's an epic RPG in miniature, and the compression isn't perfect. But few games have such enormous heart. ■ Tom Sykes

★★★☆☆

NEED TO KNOW
RELEASED November 1997
DEVELOPER Inhouse
PUBLISHER LucasArts
LINK bit.ly/2PfNdYj

I admit, the chapter at sea isn't *Monkey Island*'s strongest.

The Curse of Monkey Island

Keeping the love for a childhood favourite alive.

The first PC game I ever played was *Monkey Island 2: LeChuck's Revenge*, which was included in a magazine. Because I was a kid, I lost it or scratched it as well the set of floppy disks I ended up playing the first *Monkey Island* on, forcing me to eventually buy a bundle of both games. That bundle, called *Monkey Island Bounty Pack* came with a demo of *The Curse of Monkey Island*. The year was 1997, and I had just found the game that would likely accompany me forever.

Childhoods are filled with weird compulsions. You eat your favourite snack until the mere sight is enough to give you hives, you read the same book over and over again and you fervently declare that you will never stop loving whatever you love at the time. For many things you've loved as a child, games included, the fervour gradually cools.

We say goodbye to a lot of games we love, either due to technical constraints or simply because there are so many games to play. Sometimes we stop playing a game because we're worried the present reality won't hold up to the romantic memories we have of it. To me, *The Curse of Monkey Island* never fell into either box – I've played it at least annually for 22 years.

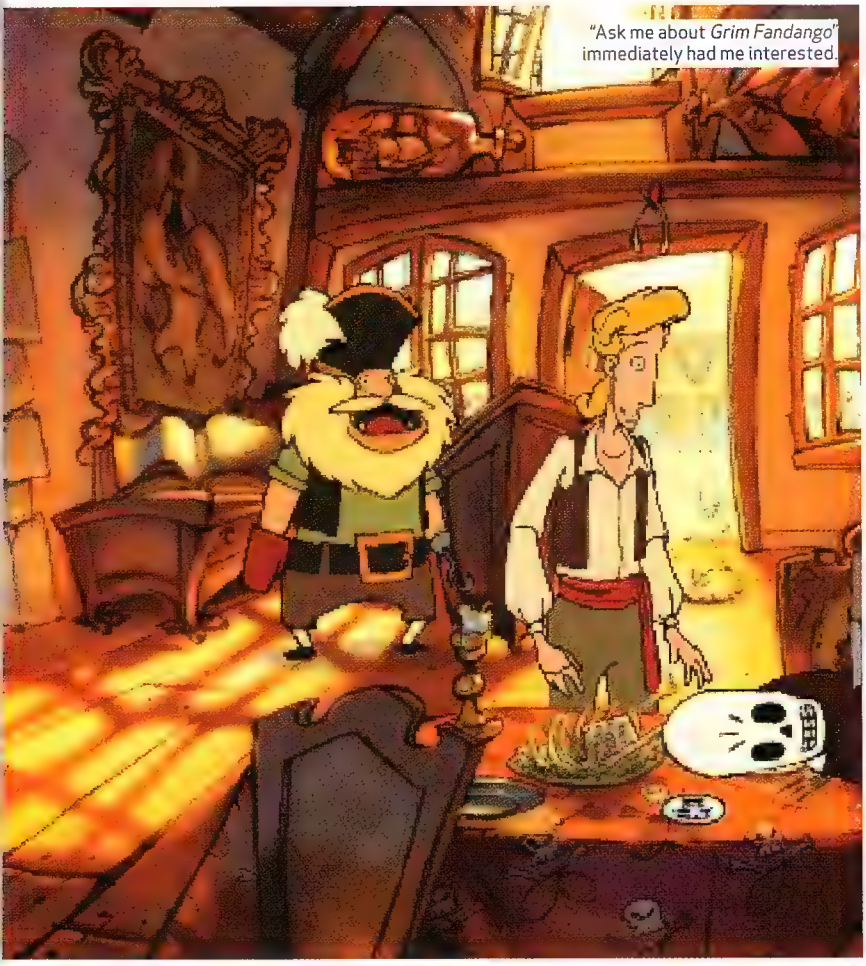
In the era of digital games that doesn't sound like much of a feat, but I've kept this game in its original box with me, moving to different flats and across countries. It felt very normal to do so; you pack your favourite book, I pack *Monkey Island* (and some underwear).

Looking at the system requirements really puts the continuous advancement of technology into perspective, right down to the paradoxical yet entirely understandable fear that your system has become too powerful to run your favourite game. 16MB RAM! Windows 95! DirectX 5!

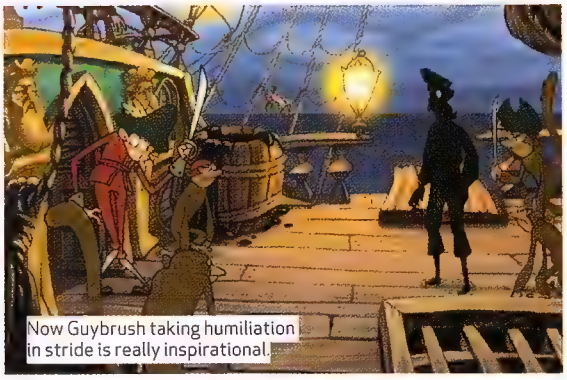
Those were different times. Miraculously, *Monkey Island* always ran fine no matter what system I used, and I didn't need to use ScummVM to run it until a few years ago, just prior to its GOG and Steam releases. I didn't play the game like clockwork, like I had to uphold a tradition, but because inevitably, one day I'd think "this feels like a good time to play *Monkey Island*".

ISLAND GETAWAY

Perhaps playing isn't the right word anymore. After this long it's more like visiting a bunch of friends, like Willy Blondbeard in his chicken restaurant or Dinghy the dog. *Monkey Island* has always been a series of characters that don't exist to fulfil any grand narrative


"Ask me about *Grim Fandango*" immediately had me interested.

"Hair from the dog that bit you" – superb hangover joke


Now Guybrush taking humiliation in stride is really inspirational.

function. Rather, they're there to be manipulated by me, so I can get whatever item or piece of information I'm after at that time.

The outline of *MI3* is simple – in order to lift a curse from his beloved Elaine Marley, Guybrush Threepwood, self-proclaimed mighty pirate, has to give her a ring symbolising true love.

He roughly knows where it is, but he needs a crew and a ship, and he hasn't really worked out the whole attaining the ring part, either.

Characters that are essentially useless props still have detailed, fun stories to tell, even when they're just built around one character attribute. Every pirate you meet, whether it's on Plunder Island, a retirement community for pirates, or out on Blood Island, the pirate family resort, each has a great yarn of a past adventure to offer, and each of them has grown on me as a result.

Since I'm unable to play the game the way it was intended to be played by now, knowing the solution to every puzzle by heart, this attachment to each character is likely a large part of what makes *Monkey Island* so evergreen for me. It's one of my great regrets that I don't remember how I've solved these puzzles in the pre-internet age, if I bought a guide and what happened to it.

The solutions to puzzles in any *Monkey Island* are so arbitrary that I can't imagine having solved most of them as a pre-teen without help. It's also worth noting that *The Curse of Monkey Island* isn't really an evergreen by conventional standards.

MONKEY LOVE

In 1998, *PC Gamer* put it in 33rd place on its list of the 50 best computer games ever released, but if you look at any best-of list for adventure games now, *The Secret of Monkey Island* or *Monkey Island 2* are much more likely to appear, having left a bigger impact with players overall. It took ages to appear on digital storefronts, while its precursors were remade a decade ago. These versions allow you to play with updated graphics and voice over, or with the classic 1990s pixels.

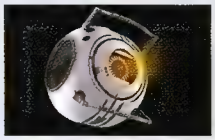
STORIED LINES Some famous quotes you might actually recognise.

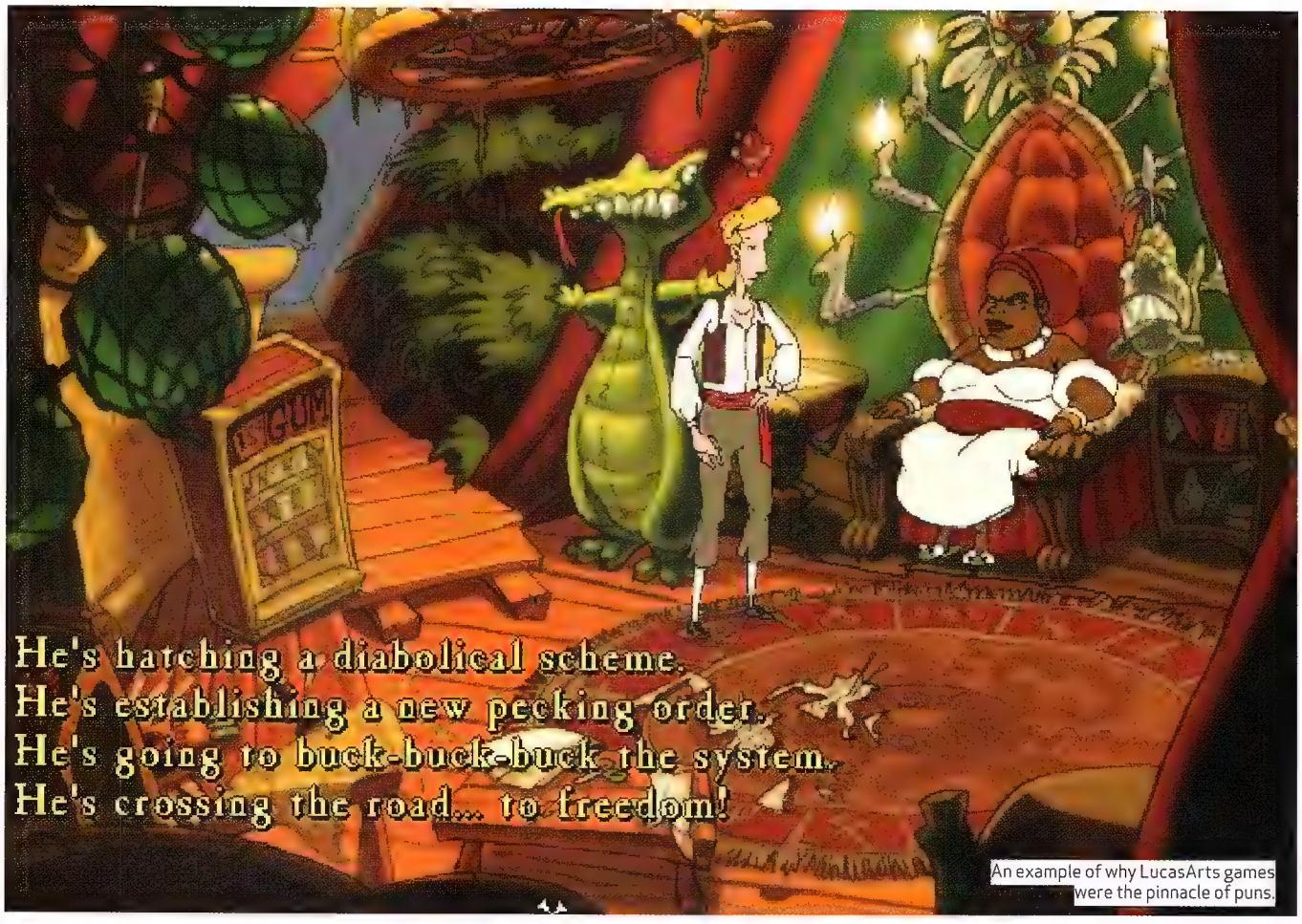
"GET OVER HERE!"
– Mr Scorpion, *Mortal Kombat*
The most famous quote of the series, pronunciation is key for this one.

"I'M IN THE MIDDLE OF SOME CALIBRATIONS."
– Garrus Vakarian, *Mass Effect*

"NOTHING IS TRUE, EVERYTHING IS PERMITTED."
– Ezio Auditore, *Assassin's Creed II*

"SPAAAAAACE!"
– Space Core, *Portal 2*
A dream came true for this little guy. And he's voiced by Nolan North.




He's hatching a diabolical scheme.
He's establishing a new pecking order.
He's going to buck-buck-buck the system.
He's crossing the road... to freedom!
An example of why LucasArts games were the pinnacle of puns.

The Curse of Monkey Island didn't need such a do-over – while I'd love to have it in HD, its 2D art style still looks fresh. It's a testament to the quality of the art that there were so many things to look at and interact with that items necessary to solve puzzles don't stand out. MI3 was the first game in the series to feature voices, immediately setting an industry standard for great voice acting in games. Many gaming franchises have a sequel that outstrips the original, but for many fans of *Monkey Island*, the first game will likely always be the best, making my love for this game, which doesn't necessarily extend to the rest of the series, a bit of an outlier.

I get it – both predecessors offer more of the swashbuckling adventure you expect of the pirate theme, here you mostly deal with pirate pensioners. Of course I love *MI3* for nostalgic reasons, too – from how it was the first game I bought with my own pocket money to how I was convinced that it represented a graphical pinnacle for PC gaming because the game looked exactly the way it did on the box.

"It was the first game I bought with my own pocket money."

LucasArts completely overhauled its SCUMM engine for one last hurrah to produce the look of *MI3*.

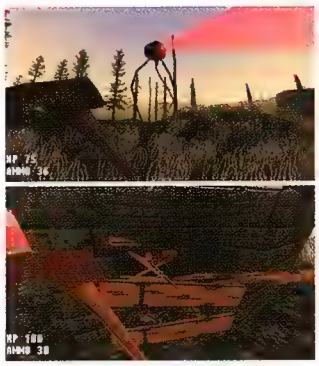
INSPIRATIONAL QUOTES

More interesting than the impossible question of why you fall in love with a game is how that love turns into something enduring. In my case it was *Monkey Island*'s unmatched quotability. I don't mean "you fight like a cow" or anything involving three-headed monkeys.

Instead, I have a huge list of completely unsusceptible quotes everyone around me knows must hark back to something, but no one ever bothers to ask me about. My favourites are exclamations of surprise, "Aah! Death again!" comes from Madame Xima at the Goodsoup Hotel on Blood Island – it has been my go-to to express surprise. When someone asks me to do something, I may ask them to beat me in the caber toss first. This is one of the tasks Guybrush has to cheat his way through to gain Haggis McMutton as a member of his crew. "I think I'm getting better at this," isn't much of a quote, but it's me channelling my inner Effette Lafoot, the temp lowering Guybrush to the smuggler's cave on Skull Island.

None of these quotes have meaning beyond what I've ascribed to them. You can't put them on t-shirts or posters, they don't immediately bring an image to mind, but they're the best way to always have something you love with you, reinforcing the memory of good times. While it's fun to explore my attachment to a game that isn't an obvious first choice for many people, in the end you form attachment over the weirdest things and sometimes love a game, just because. ■

Malindy Hetfeld



The Last Resistance

Rage against the machines.

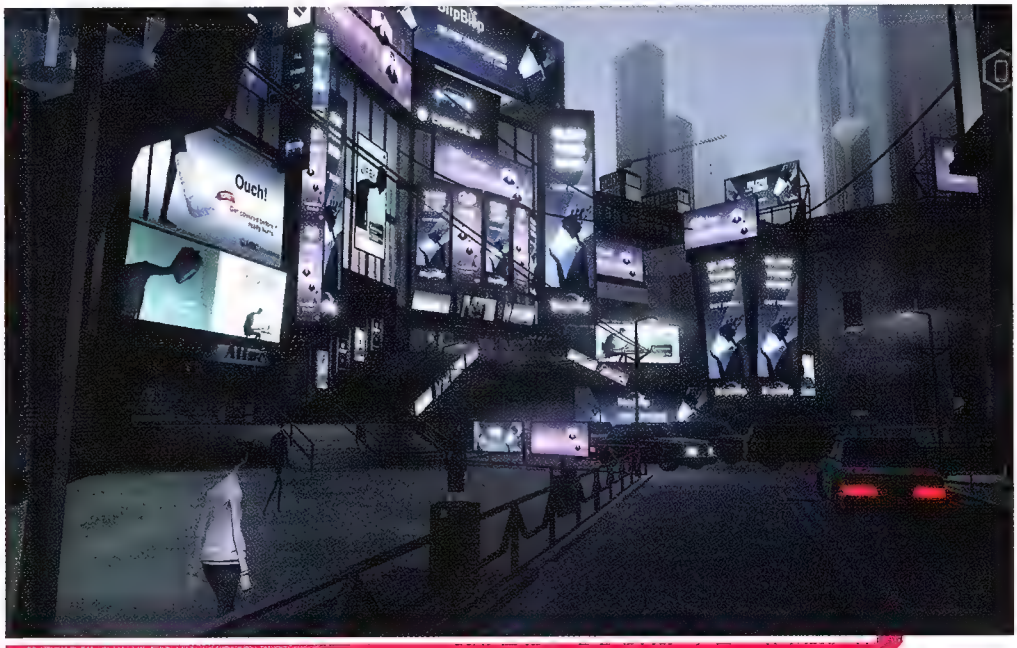
FREE | PC | SPOLAND.ITCH.IO/THE-LAST-RESISTANCE

Wilderness and robots make for an evocative combination. Playing out like a very, very small-scale *Far Cry*, you're dropped into a refreshingly Nordic open space that offers maybe ten minutes of exploration as you increase your arsenal enough to eliminate a robot threat.

You start the game with no weapons, but pretty soon you'll find an axe and then a shotgun, tools that make the smaller enemies at least rather trivial to deal with. The AI of those little spider bots is decidedly simplistic: they won't stop chasing you, ever, until you're dead. Or, more likely, until they're dead, as they're far slower and weaker than you are. The massive, *War of the Worlds*-style tripod enemies pose a deadlier threat, and remain an ominous presence even as you increase in killing power.

The Last Resistance, however, is a small game. Not just in terms of map size, but in its progression: you acquire the axe, and then the shotgun in a linear order. While you likely won't replay it, there's something to be said for a game where you can destroy a robot army during your coffee break.

■ Tom Sykes



$29 | PC | WWW.MOSAICCORP.BIZ

Mosaic

Wallowing in day-to-day drudgery.

Mosaic's sales pitch: forget the straightforward thrills of action and/or adventure, here's a game that simulates the tedious grind of everyday life.

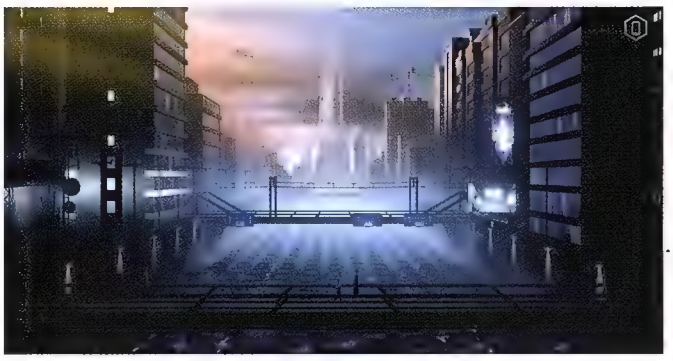
Using point-and-click controls, you drag your character – an anonymous office worker with a wonky tie, a smartphone and not much else in the way of a discernible personality – through this loop five times, a full working week of low-level misery. Which raises the question: why exactly would you want a second life that's just as rubbish as the first?If *Mosaic* was able to answer for itself, I suspect it'd be a mumble about art and mirrors and reflecting reality.

There are some sharply observed moments here, like the daily elevator ride you share with two strangers. Seemingly the only control you have over your character is which way he looks – so much as glance in a stranger's direction, and they'll do everything they can to avoid meeting your gaze. At which point, you realise there is a second thing you can do: look at your phone. This is the big message *Mosaic* has to impart: Modern life, eh? We're all scared of one another and we're always looking at our screens.

There are no real puzzles to speak of, or gags and insights to be accessed by clicking on background details. For the most part, you just move through the story. There are exceptions, mind. Every day when you arrive at work, *Mosaic* switches to a very simple hex-based strategy game. It's half-baked, but possibly intentionally so – work isn't supposed to be fun, after all. Outside of the office, there's the occasional bright spot to be found along your commute: watching a butterfly or sinking into your own imagination. These moments are presented as off the beaten path, and some of them even are, toying with those well-trained gamer instincts that, if you're supposed to go right, you should try heading left first.

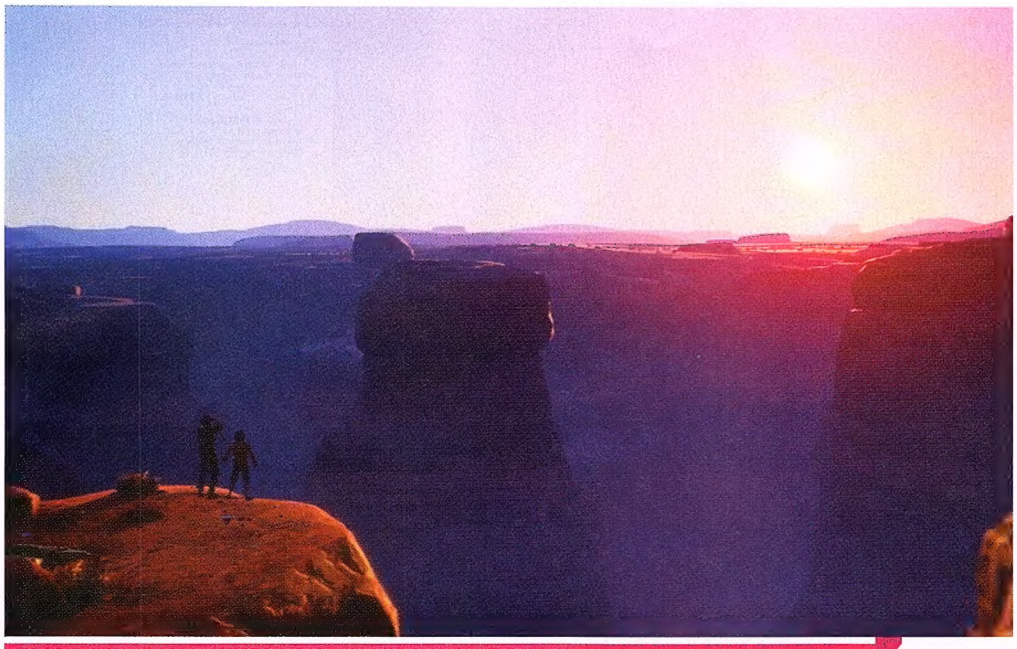
You might consider that question, why you'd want to live someone else's tedious life and conclude that, frankly, you don't. And you wouldn't be wrong, exactly. But *Mosaic* is at least an occasionally fascinating way of boring yourself.

■ Alex Spencer



Verdict

A game about breaking free from monotony that gets, perhaps inevitably, a little monotonous.



$12 | PC, XO, MAC | LIFEISSTRANGE.SQUARE-ENIX-GAMES.COM

Life is Strange 2

Far too focussed on the finish line.

Life is Strange 2 begins in suburban Seattle, where a fatal misunderstanding forces Sean and Daniel to flee their home. In his panic, Sean takes his brother on the run, aiming for his father's family home in Puerto Lobos, Mexico, and the pair take the first steps on their year-long journey to the border.

His decision provides an impressive backdrop to their adventure – but also forces *Life is Strange 2* to immediately undermine its road-tripping raison d'etre. Rather than directly portray a 2,500km journey, developer Dontnod sticks to its series' classic tropes. Exploration, dialogue, and character development are its strengths, but those are difficult to achieve within the confines of a Greyhound bus. Instead, the story moves from vignette to vignette, with each chapter set months after the one before, in a place where Sean and Daniel can stay in relative safety for a few days or weeks.

Here lies the game's most existential dilemma. These havens provide a place to live almost entirely off-grid, a rare opportunity to lay low and take stock. In one episode, whole chunks of dialogue are given over to the idea of holding out for next month's paycheck, while another places the brothers firmly within the nuclear family they both so clearly crave. Those themes, of financial security and familial responsibility, are woven throughout the game, but their importance pales in comparison to Dontnod's desire for a classic roadtrip, and so Sean and Daniel are moved on, irrespective of the decisions made within the episode.

This problem is exacerbated by the fact that *Life is Strange 2*'s most powerful tool is not directly in your hands. While players control Sean, it's Daniel who boasts supernatural abilities. Its desire to stick to the series' tropes means you're forced into setpiece after setpiece on your inevitable road to Mexico, without any desire to cater to the player who just wants to be a good big brother.

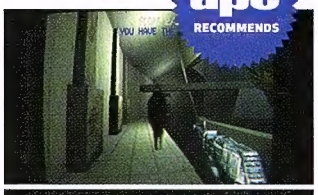
■ Alistair Jones

Verdict

Promises a classic American roadtrip, but it fails to put you in the driving seat.

★★★½☆

apc RECOMMENDS



No players online

From robots to no bots.

FREE | PC | PAPERCOOKIES.ITCH.IO/NO-PLAYERS-ONLINE

There's something eerie about a public space that is devoid of people, a fact that this first-person horror utilises to its advantage. It's set in an online FPS, but one where you're the only player.

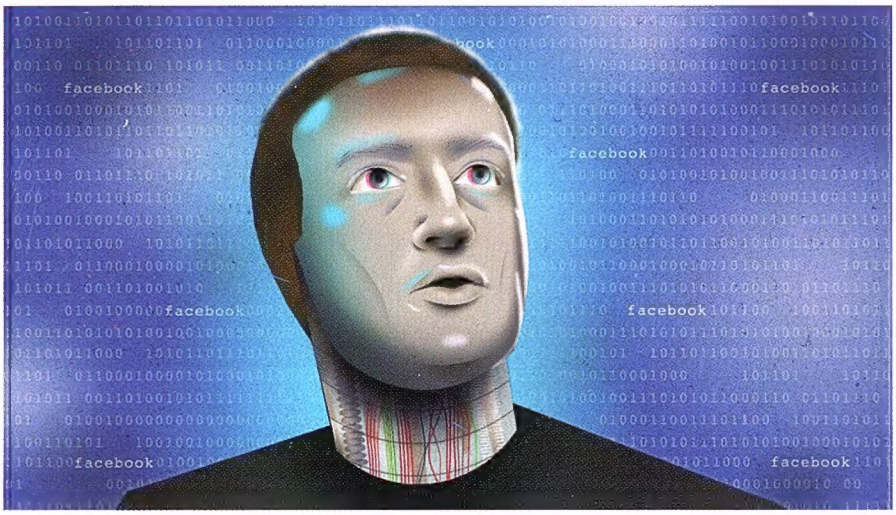
Without revealing too much, the abandoned server you're playing on isn't quite as empty as the game initially suggests. A presence that makes itself known as you play a (seemingly futile) game of Capture the Flag. It's this steadily growing anticipation that makes *No Players Online* so wonderfully tense to play – you just know something will happen as you run from capture point to capture point. But what will that be, exactly?

As *NPO* comes to a close, and its cards are laid out on the table, it becomes clear that it owes something to the technological horror of the *Ring* series. If the final revelation is a bit preposterous, then it's hard to fault the general theme of the game: what are old servers but essentially graveyards haunted by the people that have abandoned them?

■ Tom Sykes

★★★★☆

» JOEL BURGESS REPORTS ON THE UNUSUAL SIDE OF TECH NEWS.

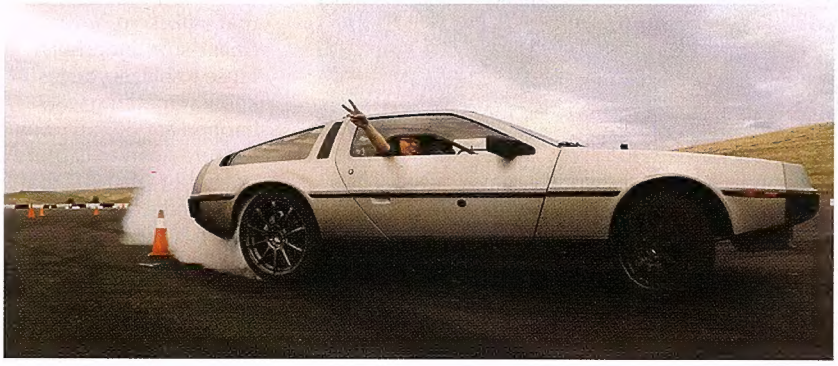


Facebook's new chatbot will defend employees from haters

Liam bot will take the heat from friends over the holidays.

Whether it's the ongoing effects of the Cambridge Analytica scandal, the failed attempt to convince everyone that Libra was a good idea, or its widely unpopular stance on allowing lies in political advertising, Facebook is not in the public's good books right now. But instead of giving its employees a show of good faith with some assuring 2020 resolutions, Facebook instead made a chatbot, called the Liam Bot, to help employees manage difficult questions over the Christmas break.

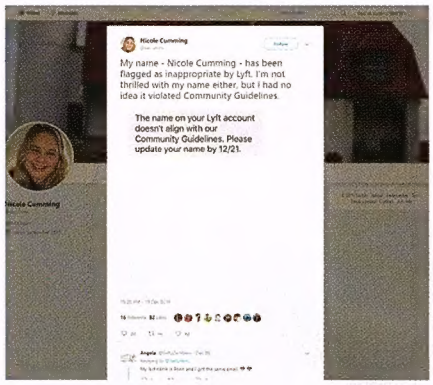
While our first thought was that Mark Zuckerberg may have just uploaded his consciousness to Liam Bot's servers, the chatbot seems far too human-like for this to be the case. Liam Bot is also much better at placating any radical relatives without needing to back down from the company's core 2020 mission: To ensure politicians have a public platform where they can lie to a large audience without any form of accountability.



Stanford designs drifting AI-driven DeLorean

MARTYKHANA IS THE KEN BLOCK OF SELF DRIVING CARS.

Researchers at Stanford's Dynamic Design lab are attempting to make autonomous driving software safer by developing an AI driving agent that will drift around a gymkhana track. This AI stunt driver is named Martykhana – a combination of references to the driving obstacle course it's tasked to navigate and the fact that it's using a converted all-electric 1981 DeLorean, similar to the one Marty McFly drives in *Back to the Future*. While the high speed burnout machine looks anything but safe, the team hopes the testing it'll do will give self-driving cars the capabilities to handle better in extreme out-of control circumstances.


Nicole Cumming
My name - Nicole Cumming - has been flagged as inappropriate by Lyft. I'm not thrilled with my name either, but I had no idea it violated Community Guidelines.
The name on your Lyft account doesn't align with our Community Guidelines. Please update your name by 12/21.

Lyft tells users their last names violate guidelines

'WHAT'S IN A NAME?'

Are you a Dick? Or a Cox? Maybe you're a Cummings. If you are any of these, then Lyft is going to stop you from signing up to its rideshare platform, since your very existence 'violates its community guidelines'. In a string of somewhat comical auto-generated ultimatums sent by the San Franciscian Uber alternative, people with rude names, legal or otherwise, have been sent texts alerting them that they must change their name or risk being booted from the platform. It seems only reasonable… why would Lyft want to stoop to the level of birth certificates and passports to let these unspeakable people sully the unblemished family-friendly Lyft service with their legal names.

London's electric buses introduce synth sounds for awareness

ELECTRIC BUSSES PUMP ELECTRO MUSIC SO YOU KNOW THEY'RE THERE.

London is often considered to have a vibrant underground electronic music scene, but the city is about to get an upgrade to its above ground digital music scene too. The iconic double-decker London busses were recently converted to electric vehicles, which means they no longer emit large plumes of cancer causing fumes, but there's also the unintended consequence of making them silent and thus potentially deadly to unaware pedestrians. To remove this risk, London Transport hired Zelig Sound to create a pair of ambient electronic noises to play when the bus was stationary or travelling at less than 20km/h. ■

BILLION

Our telecommunication capability can grow your business in entirely new ways. Stay connected Stay secured

BiPAC 8920NZ

CAT.6

M2M Dual-SIM 3G/4G LTE Embedded V/ADSL2+ Wireless-N VPN Firewall Router

- Triple-WAN approach –VDSL2, ADSL2+, 3G/4G LTE or Ethernet WAN for broadband connectivity
- 3G/4G LTE embedded with dual-SIM card slots
- Support LTE CAT 6; up to DL:300Mbps and UL:50Mbps
- Auto Failover/ Fallback feature to ensure an always-on connection
- 16 IPSec VPN tunnels supported

VDSL2 ADSL2+ | Dual SIM | 802.11n | IPv6 Support | Firewall | VPN Security

First International Trading Pty Ltd.
Unit 35, 7-9 Percy Street, Auburn NSW 2144
Phone: (02) 8318 3777

Email: sales@billion.com.au
sales@firstint.com.au

au.billion.com

The home of technology

techradar.com